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THE AMERICAN

JOURNAL OF PSYCHOLOGY

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EDITORIAL.

When the AMERICAN JOURNAL OF PSYCHOLOGY was founded in 1887, it was a pioneer in its field. It represented the department of psychology at the Johns Hopkins University, was for years the only one of its kind in the country, and the establishment of which, as its subsequent history shows, was one of the boldest and most sagacious as well as one of the most successful and beneficent steps ever taken by this leader of the new academic movement. Here vigorous and creative minds like Cattell, Dewey, Jastrow, Donaldson, Cowles, C. L. Franklin, Hodge, Burnham, Patrick, Noyes, Nelson, Motora, Stevens, Edwards, and others, all of whom have enriched the department by original contributions in the JOURNAL, received, some a part and some all, of their special training. There was almost no outside aid, and for years practically no competition in any land or language. For years the struggle for existence was severe, and the editor himself did a good part of the review and other unsigned work, and made good the large annual deficit from his own pocket. Since moving to Worcester the JOURNAL has depended for original articles largely upon members of Clark University, men already prominent or promising in professonial position or productivity, like Franz Boas, A. F. Chamberlin, B. I. Gilman, B. C. Burt, Alfred Cook, C. A. Strong, A. MacDonald, Le Rossignol, W. L. Bryan, T. L. Bolton, Frederick Tracy, W. O. Krohn, Gerald M. West, A. H. Daniels, E. W. Scripture, Herbert Nichols, Alexander Fraser, F. B. Dresslar, John A. Bergström, Frank Drew, J. H. Leuba, H. T. Lukens, Colin A. Scott, G. W. A. Luckey,

G. E. Johnson. Under the influence of these men departments of experimental psychology and laboratories were founded at Harvard, Yale, Philadelphia, Columbia, Toronto, Wisconsin and many other higher institutions of learning; text-books have multiplied; other workers no less able who were trained abroad and elsewhere have come into the field; psycho-physics, neurology, the psychology of the insane, criminals, blind, deaf, idiotic and other defective classes, studies of animal instincts, anthropology and childhood, which the JOURNAL was the first to make it a leading purpose to bring out of their isolation into fruitful reciprocity,—have been well coördinated and other periodicals established. The JOURNAL invited and presided over the establishment of the American Psychological Association, which is the first organization in the country in which teachers of psychological and other philosophic subjects, who in the past have found it difficult to co-operate, have been united and felt some degree of *esprit de corps*.

It is now because recent developments enforce the necessity of defining and emphasizing anew a standpoint which is scientific, without mystic infiltration, unitary enough not to mix the most opposite tendencies in rococo confusion in the same journal and even text-books, and American in that instead of mere discipleship to past or present leaders, or excessive deference to European thinkers, it is clearly seen that our own country is in dying need of a science of man larger than any or all of the systems, that the AMERICAN JOURNAL OF PSYCHOLOGY, instead of lapsing, as it might well do after such service, to become the organ of one laboratory, takes up again its task, which is far harder even than before, but with greater resources and a settled conviction that the immediate future will see yet greater changes than the past, year for year, and with even greater courage and ardor than when it first started.

From the first the JOURNAL has slowly and steadily grown and now pays all its expenses, and with the present number begins changes and improvements along the following lines:

I. Several slight modifications in form.

II. A new department of notes, to which contributions are invited.

III. An international corps of editors and contributors, who will contribute and write reviews.

IV. An improved method of finding and obtaining IMPORTANT literature on the lines defined below, and of having it promptly noticed, digested or reviewed, so that our Review Department be not limited to what publishers choose to send.

Our suggestion to our reviewers is to make each review a miniature of the original, embodying its every new and salient phrase and idea, but boiled down to the utmost consistency, appending criticism, if any, in a final paragraph. This work is often so poorly done that the services it may render are but little known. These digests should be more *striking* than the original itself, where transitions are more gradual, the whole not seen in all its proportions at once. It is believed that publishers and readers alike will welcome this method.

V. Exclusion of all advertisements whatever, save occasional friendly exchanges with other scientific journals in cognate lines. By thus admitting between our covers only such titles among the vast mass of publications as we deem most worthy the attention of our readers, our reviews may perhaps be kept more impartial.

VI. A sharply defined field for both articles and reviews as follows:

I.

The results of experimental investigations in psycho-physic laboratories. To this *Archiv* function, not yet represented by any serial publication in this field in English, we are ready, if fit matter be forthcoming, to give most space, and should be glad to become the organ in which any American laboratory can be sure of publication in the order of its reception of any contribution of the methods or results of original research that is both new and important, and to print memoirs of greater length than has been possible hitherto, up to the utmost limits of our practical resources, provided, always, that there is the greatest practicable condensation and elimination of excessive discussion and unimportant details, to which young investigators in this field are so prone. Prominent German experimenters have illustrated that there

is such a thing as over-production of statistical tabulation on the one hand, and a use of exact apparatus in a way so lacking in rigor and severity as to positively embolden the speculative propensities so inveterate in this field, while in this country much of the psychology of the last decade is by "arm-chair professors," who lack patience for the tedious details of laboratory research as well as the instinct for concentration and specialization that can focus their efforts upon anything less than the entire field of psychology. This JOURNAL desires to represent neither of these tendencies, nor the disposition, now also too rife in this period of rapid transition, to press imperfectly established observation into the service of old discussions concerning problems not yet soluble by science, such as epistemology, the nature of consciousness, the freedom and essence of the will, the ego, immortality, etc., or idealism generally, on the one hand; or molecular tremors, phosphorescence, memory cells, chemical and electrical tropes by those who are neither chemists nor electricians, etc., or materialism generally, on the other hand.

II.

Studies in abnormal psychology, including the insane, criminals, idiotic, blind, deaf, or other defectives or degenerates. Here belong a large number of border-land phenomena not yet adequately represented in medical literature. Here premature conclusions, like the existence of a magnetic fluid, telepathy, spiritism, dream signs and prophecies, etc., which represent the largest number of articles thought by their authors to be psychological, but which the JOURNAL has had to decline, not purely because the bottom facts recorded were not of great interest and importance, but because the observation was utterly uncritical and distorted by crude superstition or crass theory on the one hand, and the Lombroso-Nordau tendency to find symptoms of disease or decadence in every exceptional trait or act, forgetting that the rough symptom groups found practical for the clinic are not the categories by which to diagnose the forces that make for higher human evolution and variation, on the other; — all this, from the standpoint of the JOURNAL, is far less scientific

than work in the method and spirit of Kandinsky, Krafft-Ebing, Kräpelin, Magnan, Cowles, and others. We should prefer to print studies like those the latter is now making at the palatial new asylum at Waverly, which marks a new departure in the systematic observation and treatment of the insane by combining and embodying in practical form the best new tendencies in psychology. The JOURNAL also desires to stimulate the scientific study of the feeble-minded, paupers and under-vitalized classes, as well as that of the blind and deaf,—to say nothing of freaks, cranks and other exceptional persons generally, and is fully persuaded that this field, now almost entirely uncultivated, will yield a fruitage no whit less valuable than that of the new criminology, if cultivated with equal vigor and sagacity. In this field psychology cannot experiment, but nature does so on a gigantic scale all about us, and we should now try to gather more of the lessons from her vast experiment station.

III.

The anthropology of myth, custom, religious belief, symbols, etc., among savages and ethnic stocks; rites, ceremonies and all products of the mythopœic faculty, and all expressions of the religious instinct are so spontaneous and central that it is strange that modern psychology has so ignored them. The grand old cult sometimes spoken of as conversion, the new life, regeneration, which in the old American college was central in all instruction in ethics, and mental science, as it has been in some form for adolescence in every religion, savage or civilized, can only be rescued from its present degeneration by such studies. The JOURNAL holds that anthropological is, to say the very least, no whit less important than physiological psychology as an element of philosophical training. The deep psychological significance of myth, rite, ceremonial, symbol, etc., are also just being discussed, and can be explored and utilized only by careful study and research in general anthropology, which is expected at least in one American university of all psychological students.

IV.

Closely connected with the latter is genetic psychology and exact and careful child-study by scientific observers. This movement is so recent, and by methods so new, that American psychologists have little conception of its scope. Not only is it repeating, stage by stage, the history of the laboratory movement, but marking, as it does, the first advent at last of evolution in the study of the soul, it promises to equal the latter in importance, and relegate much of the present adult psychology to those pages of history which preserve the aberration and over-subtleties of vigorous but misdirected minds. The JOURNAL can only print the most exact and scientifically important researches in this field. For those of a more popular and practical nature, another journal has been especially established *(The Pedagogical Seminary)*.

V.

Studies of animal psychology.

VI.

Neurological researches.

VII.

The psychology of philosophy, ethics, æsthetics, theology, etc. To the psychological treatment of subjects or persons in this field by the same objective and critical methods, as myth, art products, or other more naïve creations of the soul, are discussed from a more conscious and scientific standpoint, as the psychology of genius, childhod, insanity, instinct are studied, great importance is attached.

Thus the field of the JOURNAL does not include the history of philosophy, ethics, or pedagogy, for these topics are already adequately provided for in other journals. It does not include epistemology, metaphysics, sociology, or theology unless treated as above, nor offer to print long discussions concerning matters on which conclusions are impossible. The JOURNAL thus has a philosophical *standpoint* and *character*.

EXPERIMENTS ON FECHNER'S PARADOXON.

By T. R. Robinson, B. A., Toronto.

Psychology, at least at an earlier period of its history, has had to defend its claim to be considered as an exact science. The best defense of this claim consists in showing that not only are many of its problems insoluble for physics and physiology, but that for these sciences they are not problems at all. The first of the general questions of experimental psychology is that of the quantitative relation between an external excitation and the corresponding internal reaction or sensation. One of the most interesting phases of this question concerns those cases where the constituting parts of the stimulus are applied to different though coördinate sensitive surfaces, *e. g.*, in the case of the organs of sight. The present article deals with the relation of the light intensity of an object seen with both eyes to that of the same object seen with only one. Its purpose is to give a brief account (1) of the work previously done upon this problem, (2) of the writer's own work upon it.

I.

The first investigation of this problem was undertaken nearly a century and a half ago by Jurin, who found by experiment that an object appears measurably brighter regarded with both eyes than with only one. His method may be schematically illustrated by Fig. 1.

A sheet of white paper, P, was illuminated by two candles, L_1 and L_2, placed behind it. A screen, S_1, was interposed in such a way that the right half of the paper received the light of both candles, the left half only the light of one. A

second screen, S_2, was placed before the right eye of the observer in such a way as to hide from it the brighter half of the paper. The left, or less illumined half, was now seen by both eyes, and the right, or brighter half, only by the left eye. It was found that the left, or darker half, seen with both eyes, appeared about equally bright with the right, or brighter half, seen with the left eye, when the one light was about 3.4 times as far distant as the other, so that the intensities of the brighter and the darker halves bore to each other the relation

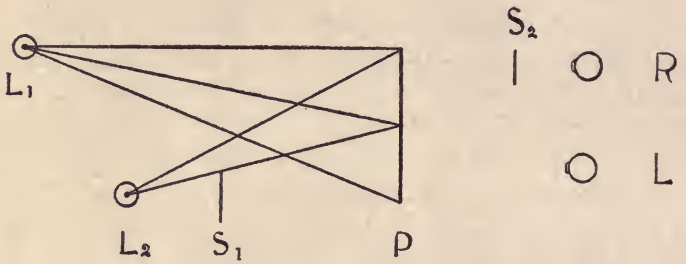


FIG. 1.

of 13 to 12. According to this result, the same object, or one equally bright, would appear in binocular vision $\frac{1}{13}$ brighter than in monocular vision.

The problem was dealt with by a somewhat more accurate method by H. H. Valerius in 1873, by means of an application of Faucault's photometer. This photometer consists of a box, the interior of which is lined with black cloth to prevent the reflection of light rays. In one end of the box is a semi-transparent glass disc, placed so as to admit the lights whose intensities are to be compared. The box contains a sliding diaphragm, which, by means of a screw, can be placed nearer to or further from the disc. The lights to be compared are now placed one on each side of the diaphragm, in such a way that by adjusting the distance of the diaphragm from the disc, each light illumines exactly one-half of the disc. The observer, looking from the outside at the disc, adjusts the distances of the two lights from the halves of the disc which they respectively illuminate, so that the whole surface of the disc appears equally bright.

Then these distances are measured and the relative intensities of the light determined by the rule that they will be inversely as the squares of their distances from the illuminated object. Since Valerius has not illustrated his article by diagrams, it may be worth while to attempt a schematic representation of his arrangement in Fig. 2.

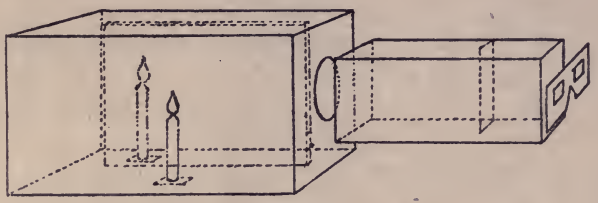


FIG. 2.

The mode of using this apparatus in the experiments of Valerius was as follows: The two lights were introduced as though their intensities were to be compared and adjusted, so that the whole surface of the disc was equally illuminated and their distances noted. The observer looks through the tube, keeping the position of the head constant by means of a screen, with openings for the eyes and a slit for the nose. In the interior of the tube is a diaphragm, which conceals one of the vertical halves of the disc from one of the eyes of the observer. The result is that one of the vertical halves of the disc is seen with both eyes, the other with only one. When this is the case, the half seen only with one eye appears less bright than the other. This is remedied by moving the light which illumines the former nearer to the disc, until the two halves again appear equally bright. This new distance is also measured and compared with the former distance of the same light. Now, if we denote by I the brightness of the half of the disc under consideration when the light is at the first distance d, and by J the brightness when the light is at the lesser distance d', there is between J and I the relation $J:I::d^2::d'^2$, and, consequently, since the intensity I of the light seen with both eyes is equal to the intensity J of the same light seen with one eye, we have as an expression of the relation of the light intensities of binocular and

monocular vision the ratio $d^2 : d'^2$. The following is Valerius' statement of his experiments and their results :

FIRST SERIES, MADE WITH THE FLAMES OF TWO CANDLES.

Distance of Right Candle from Right Half of Disc.	Second Distance.	Relation of the Two-Light Intensities.
100 Ctm.	94 Ctm.	1.15
75 "	71 "	1.11
62 "	53 "	1.14
41 "	38 "	1.16

SECOND SERIES MADE (BY ANOTHER OBSERVER) WITH TWO GAS FLAMES.

Distance of Right-Hand Flame from Right Half of Disc.	Second Distance.	Relation of the Two-Light Intensities.
100 Ctm.	94 Ctm.	1.13
75 "	71 "	1.11
62 "	57.5 "	1.16
41 "	47.5 "	1.18

From these results Valerius draws the following conclusions : 1. The relation of the light intensities of the same object, observed successively with one eye and with two, appears to be almost entirely independent of the absolute intensity. 2. For weak lights, such as those of the ordinary candle or gas flame, this relation does not vary much from 1.15.

These early experiments, though scientific in principle, are defective in several respects.

1. The methods of both Jurin and Valerius are open to the objection, which Valerius afterwards noticed, that the sensitiveness to light of the two eyes of the same individual is commonly not the same, and this may materially affect the result.

2. The two eyes were not, in the experiments, subjected to the same treatment. One eye received continuously more light than the other.

3. Though the object observed was screened from one eye, much light was still admitted to that eye, a fact that would doubtless have an influence on the intensity of the whole.

4. The trials were not sufficiently numerous or varied to

warrant the conclusion of Valerius that the relation does not depend on the absolute intensity, nor does that conclusion seem to be borne out by the trials that were made; for the relation seems to vary with the absolute intensity, though there is not much constancy in the results. Another consideration overlooked by Valerius was that it is only possible for the absolute intensity to affect the relation if the first impression both of the one eye and the two are taken, for after the observer has looked for some time at the object, the eyes become adapted to the absolute intensity, so that it can no longer affect the relation.

5. It would appear that both Valerius and Jurin fix the relation too exactly, because they take no account of the subjective conditions on which the results of their experiments must in large measure depend; for we are not comparing absolute light intensities, but only the intensity of light sensations.

Fechner made, in 1860, some experiments at Leipsic, from which it appeared that with most observers the closing of one eye caused a slight darkening of the whole visual field, followed immediately, however, by a restoration of its brightness, whence he concluded that the intensities of monocular and binocular vision are equal. Aubert, however, following the method of Fechner, found that the light intensity of the whole visual field was somewhat greater when both eyes were open than when one was closed, provided that the absolute intensity were not greater than that of white paper in diffused daylight. These experiments do not, however, possess much value for the solution of our problem (viz., to find how much the intensity of monocular vision is increased by the addition of the other eye), because they seem to have been made with reference to continued observation both in binocular and monocular vision, where the one eye, becoming accustomed to working alone, is not in the same condition as if the first impressions had been taken.

In the course of further trials, under different conditions, however, Fechner found: (1) That when the visual field of one eye is darkened by means of a smoked glass, and then the common visual field, or a white object in the common

visual field, is regarded, the latter appears darker than if the eye partially obscured by the glass is closed. (This, Fechner calls the "paradox trial," because the total darkening of one retina causes a brightening of the whole visual field.) (2) That an equal darkening of the common visual field results from placing before one eye a glass which absorbs very little or one which absorbs very much light. This equal darkening of the whole visual field, by unequal components, Fechner calls the conjugate intensities. With a certain light absorption occurs the maximal darkening of the whole vision; this point Fechner calls the minimum point.

In these experiments the darkening continued for some seconds, so that its extent could be estimated. But if the glass before one eye were very dark, and the observer continued to look, for say a minute, there occurred an alternate darkening and brightening, the so-called competition phenomenon of the visual fields. For this reason Hering regards Fechner's trials solely as instances of the competition phenomenon. Helmholtz, on the other hand, holds that in these trials we have not a change in the sensation of brightness, but only a change in our judgment regarding the surface-color of the white object. Aubert rejects both these views as inconsequential, though he admits that the use of an object with strongly marked lines or contours has naturally a disturbing effect upon the simplicity of the light sensation. According to Aubert the trials show that a combination of the sensations of the two retinas occurs when the difference of their intensities does not go beyond a certain point, which the experiments themselves must determine, but beyond this point the capability of combination decreases and finally ceases altogether. He thinks, also, that the absolute intensity of the object affects the possibility of combination.

In the similar experiments made by Aubert himself, a double episkotister was used, having fixed before it a screen with openings for the two eyes of the observer. One disc corresponds to the lighter smoked glass of Fechner, the other to the darker. The episkotister has the advantage of giving an exact determination and variation of the intensity,

and also of furnishing an absolutely colorless grey, while the smoked glasses have almost always a certain color, which makes it extremely difficult to compare their intensities. The greatest darkening in the common visual field occurred in Aubert's experiments, when one eye was free and $\frac{122}{1000}$ of the full light was admitted to the other; *i. e.*, if the intensity of the full light = 1,000 when a light of the intensity of 122 is admitted to one eye while the other is unobscured. On the admission of less light, the common visual field appeared brighter, and the same result followed on the admission of more light. There must, therefore, be found total intensities which are equal to each other when one eye looks through a disc, which admits say 55 parts of light, or through one which admits say 500. Fechner represents these numbers on a curve, the shortest ordinate of which corresponds to the greatest darkening in the common visual field; the lowest resulting point of the curve he calls the minimum-point, the equal intensities in the common visual field upon the greater and less darkening of the one eye the conjugate points of the curve. This mode of representation, with the modification required by the slightly different results of Aubert, may here be reproduced in Fig. 3.

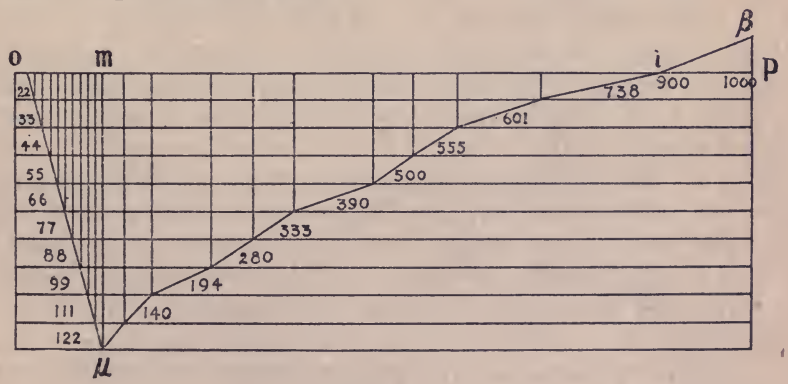


FIG. 3.

op. represents the intensity of the light sensation of the whole visual field when one eye is closed. The point β of the ordinate above *op.* represents the somewhat greater intensity when both eyes are open, which, according to Aubert,

makes a difference of about $\frac{1}{10}$, rather more than Valerius or Jurin found it; μ, the lowest point of the curve, represents the minimum-point, which corresponds to the sensation of least light in the common visual field when one eye is unobscured. This point was reached when for the other eye 0.122 of the full light was admitted by the episkotister, and the darkening of the whole visual field was then as great as when with monocular vision 0.583 of the full light was admitted. These numbers Aubert found to be somewhat different when, instead of a sheet of white paper in diffused daylight, he took as objects, successively, the sky, the white glass shade of a lamp and the free lamp flame. His results concerning the conjugate intensities may be given in the following table corresponding to Fig. 3.

Paper.	White Glass Shade.	Sky.	Free Flame.
22 = 738	16 = 750	16 = 700	16 = 444
33 = 601	22 = 666	22 = 500	22 = 377
44 = 555	33 = 400	33 = 333	33 = 333
66 = 390	44 = 333	44 = 128	44 = 250
77 = 333	55 = 250	55 = 83	55 = 200
88 = 280	66 = 166	66	(66 - - - 166)
99 = 194	(77 - - - 140)	(333)	
111 = 140			
122 = (417)			

In explanation of the general phenomena of the coöperation of the two eyes, there are, according to Fechner, three theories.

1. The combination theory, according to which the total intensity equals the sum of the monocular intensities, where this sum is subject, of course, to the same condition as all summation of intensities (*i. e.*, Weber's law). This theory agrees with the fact that the intensity of binocular vision is not double that of monocular, but it does not explain why under certain circumstances a decrease of physical intensity causes an increase of intensity in sensation.

2. Theory of attention. According to this theory, in the case of smaller differences of the impressions, the attention is distributed upon both the impressions, while in the case of greater differences the attention is directed exclusively to the

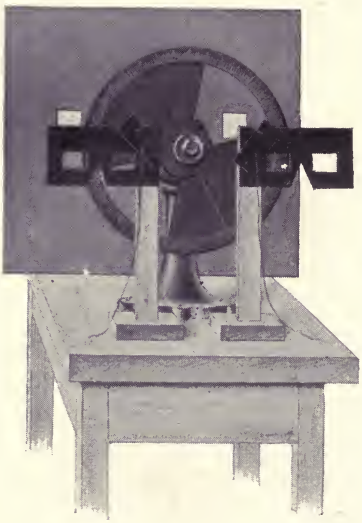


FIG. 4.

brighter retinal image. This is the theory which seems to be favored by Aubert. It may be objected that the same thing should hold good in the different parts of one retinal image, where all parts are not equally bright, *i. e.*, the brighter part should monopolize the attention to the exclusion of the other. Further, it is an error to speak of the two retinal images as if they existed separately in consciousness. In our perception there exists only *one* visual field. That we regard *two* similar images in this visual field sometimes as belonging to two similar objects, and at other times as double images of the same object, does not depend on the intensities of these images.

3. Theory of antagonism. This is Fechner's own theory. It explains the phenomenon as coming under the general phenomenon of competition of the visual fields. According to this view, the impressions of the two eyes are combined when the difference of intensity and quality are not very great, while in the case of greater differences no combination takes place, but either the one of the images (generally the less bright) is suppressed entirely, or the two images replace each other alternately.

The above is a short résumé, so far as the literature of the subject was obtainable by me. The following are the references: Valerius, Poggendorff's Annalen, Band CL, p. 317; Jurin, Smith-Kästner, Lehrbegriff der Optik, 1755, p. 479 (Jurin's work is also reported by Aubert); Fechner, Binoculares Sehen, in Abhandlungen der Akadamie in Leipzig, 1860, Band VII, p. 423; Aubert, Physiologische Optik, p. 499, and Physiologie der Netzhaut; Helmholtz, Optique Physiologique, 1st ed. p. 964; Wundt, Physiologische Psychologie, Vol. II, 4th ed., p. 210 ff.

I shall now add an account of some experiments made during the current year in the psychological laboratory of University of Toronto, under the supervision of Dr. Kirschmann.

II

The apparatus employed in this work was a single episkotister turned by an electric motor, as shown in the accompanying cut, Fig. 4.

Behind the episkotister were placed the objects to be observed. In a large sheet of black card-board two square holes, 3½ ctm. square, were cut and covered with white tissue paper, and behind each opening was placed alternately an incandescent lamp of 32-candle power. The intensity of the light was varied by using more or fewer sheets of tissue paper. The episkotister was graduated in 360°, and was arranged so as to vary the light admitted between the limits of 0° and one-half the total intensity (=180°). The illuminated squares were placed in line with the edges of the disc, one on the right hand, the other on the left. In front of the disc were two screens with openings for the two eyes of the observer, and slits for the nose in order to keep the head steady. These screens were placed so that through one of them the right hand light was seen, through the other the left, and were also arranged in such a way that by means of them one eye saw the light through the episkotister, the other looked directly at it. The small shutters shown in the cut were used to cover the eye, for which the light was partially obscured by the episkotister. During the experiment all other light than that of the electric lamp in use in the experiment, was carefully excluded from the room. In the use of the *two* objects and *two* screens there was a double purpose: (1.) To avoid possible errors due to a difference between the two eyes of the observer. (2.) To subject both eyes throughout the experiments to the same treatment, and so to avoid another source of error.

Before describing the method adopted in the experiments, it is necessary to more clearly define their object. There are two questions which do not seem to have been clearly distinguished by former investigators: (1.) The question, to what extent an object appears brighter or darker accordingly as it is continuously regarded under similar conditions with two eyes or with one. Here we have to do with a continuous state in coöperation or non-coöperation. (2.) The question, how much intensity of light sensation is added to that of monocular vision by the addition of the other eye, or subtracted from that of binocular vision by the closing of one eye? Here we deal with the immediate effect of a change. Viewing the

problem from the first standpoint, we have to seek for an equation between binocular and monocular intensities. From the other standpoint the problem presents itself as follows: For every intensity in monocular vision there exists a certain other intensity, the admission or non-admission of which to the other eye has *no effect* on the total intensity. To find for some cases these physical intensities, which, as far as it concerns the intensity of light sensation, are entirely ineffective, is the purpose of our experiments.

Fechner's paradox trial had shown that if one eye were partially obscured by a smoked glass or similar means, there occurred a brightening of the whole vision field when that eye was closed. It appeared, however, from some preliminary trials, that this is only true if a glass is used which absorbs most of the light. On the other hand, if a glass or episkotister is used, which absorbs comparatively little light, on the closing of the one eye the whole visual field appears darker. Between these limits, therefore, there must be, corresponding to Aubert's and Fechner's minimum-point, an indifference point, where no difference will appear in the intensity of the common visual field, or of an object in the common visual field on the closing of the one eye. To find this point, then, was the object of these experiments.

Placing himself before the left-hand screen of our apparatus with his eyes to the openings, the observer looks at the white square with the left eye free and the right eye darkened by the episkotister, admitting only a few degrees of light. After looking for a moment he pulls the string attached to the slide, thus shutting off the object entirely from the right eye, and immediately reports whether the object looks more or less or equally bright. Then changing over to the right-hand screen, he repeats the trial, having now the right eye free and the left partially obscured. Then the episkotister is readjusted so as to admit a little more light and the trials made again, beginning this time on the right side and changing over to the left, and so on through all the degrees of light between the two extremes. It was usually found that the indifference point did not occur upon the admission of one particular degree of light, but usually extended over a considerable

number of degrees, and that often when the object had begun to appear darker or brighter, it would, upon a further change, again seem equal. At the conclusion of a series of trials the average of the equal points was taken as representing the indifference point for that series. And where, as sometimes happened, there was a sudden change from brighter to darker, a point midway between was taken as the "equal" point. All the trials were made under similar conditions by two observers. In order to vary the conditions as much as possible, one series was made beginning with the episkotister admitting 5° of light and proceeding upwards to 180°, the next proceeding from 180° to 5°, the next beginning within the limits of the "equal" points and proceeding both up and down till those limits were passed, and then going back again to the region of equality. Different absolute intensities were used and a series of trials made for each, the intensity being varied, as already said, by placing more or fewer sheets of tissue paper over the apertures. There was found to be a variation in the results in close correspondence with the variations in the absolute intensity, as shown in the accompanying table. Some supplementary trials were also made with pure colors, the results of which are also appended. In the table the absolute intensity used in the first series of trials (that of a 32, candle power lamp behind two sheets of tissue paper) is taken as 360°, and the others in comparison with it, and measured by means of an episkotister photometer.[1]

In the case of the observer K the results for the two sides were so different that they had to be given separately. The two eyes of the observer K, although in the same state refractively, are in several respects considerably different. The left eye has an iris of different color and a considerably smaller pupil than the right. With the other observer,

[1] If one tissue paper allows $(\frac{1}{n})$ of the incident light to pass, then through 2 papers $(\frac{1}{n})^2$ should be transmitted, through m papers, $(\frac{1}{n})^m$, according to the theory. By photometrical measurement the transmission through several sheets is always found to be a little greater than the computed value. This is due to the circumstance that by the contact of the different sheets the number of absorbing and diffuse-reflecting surfaces is diminished.

the combined results of the two eyes are given, though in this case, also, a difference was noticeable, though smaller and less constant.

TABLE I.

EXPERIMENTS WITH WHITE LIGHT.

Number of Tissue Papers.	Photometrically Determined Intensity.	OBSERVER: K.						OBSERVER: R.		
		LEFT SIDE.			RIGHT SIDE.			LEFT AND RIGHT SIDE.		
		Av. Value.	m.v.	Ratio of the Full Light.	Av. Value.	m.v.	Ratio of the Full Light.	Av. Value.	m.v.	Ratio of the Full Light.
2	360	$52\frac{3}{7}\frac{5}{2}°$	$4\frac{1}{7\frac{1}{2}}°$	0,146	$67\frac{2}{3}°$	$1\frac{3}{15}°$	0,188	$63\frac{2}{3}\frac{5}{5}\frac{7}{2}°$	$7\frac{3}{3}\frac{4}{5}\frac{5}{2}°$	0,177
4	210	$62\frac{4}{7}\frac{7}{4}°$	$\frac{8}{1}\frac{7}{6}\frac{}{2}°$	0,175	$73\frac{1}{3}\frac{1}{9}°$	$2\frac{7}{1}\frac{7}{3}\frac{}{5}°$	0,203	$77\frac{5}{1}\frac{7}{2}\frac{}{0}°$	$2\frac{6}{1}\frac{7}{3}\frac{1}{2}\frac{}{0}°$	0,214
6	120	$67\frac{1}{2}\frac{3}{1}°$	$9\frac{1}{2\frac{1}{1}}°$	0,188	$76\frac{2}{3}°$	$0°$	0,213	$99\frac{1}{1}\frac{1}{6}°$	$5\frac{5}{1}\frac{}{6}°$	0,277
10	12(?)	$77\frac{6}{7}°$	$\frac{6}{7}°$	0,216	$106\frac{1}{3}\frac{9}{6}°$	$\frac{3}{3}\frac{5}{6}°$	0,296	$121\frac{1}{3}\frac{5}{2}°$	$4\frac{1}{3}\frac{3}{2}°$	0,337
10 and 2 sheets of ord'y white paper.	1	$127\frac{1}{2}°$		0,354	$132\frac{1}{2}°$		0,368	165°	5°	0,458

TABLE II.

EXPERIMENTS WITH COLORED LIGHT.

Color.	OBSERVER: K.						OBSERVER: R.		
	LEFT SIDE.			RIGHT SIDE.			LEFT AND RIGHT SIDE.		
	Av. Value.	m.v.	Ratio to the Full Light.	Av. Value.	m.v.	Ratio to the Full Light.	Av. Value.	m.v.	Ratio to the Full Light.
Red	$83\frac{1}{8}°$	$3\frac{}{8}°$	0,231	$98\frac{1}{1}\frac{1}{8}°$	$3\frac{1}{1}\frac{1}{8}°$	0,274	$110\frac{5}{1}\frac{}{2}°$	5°	0,307
Green	$100\frac{5}{6}°$		0,280	$123\frac{1}{3}°$		0,343	$92\frac{3}{7}\frac{}{6}°$	$\frac{4}{5}\frac{5}{6}°$	0,256
Blue	$95\frac{5}{1}\frac{}{7}°$	$5\frac{5}{1}\frac{}{7}°$	0,265	$106\frac{1}{2}\frac{3}{2}°$	$3\frac{9}{2}\frac{}{2}°$	0,296	$118\frac{1}{2}°$	$1\frac{1}{2}°$	0,329

In Table I the numbers given as "average-values" represent the number of degrees of the episkotister, through which the light had to pass in order to produce no effect on the total intensity. These numbers are attained by averaging, in the case of observer K, the results of two double series of experiments; in the case of observer R, of four double series.

The second table contains the results of a few experiments with colored light. In these experiments the two openings

which served as objects were covered with a combination of tissue papers and colored gelatine plates. Three combinations of apparently equal brightness were selected with the help of the spectroscope. The one permitted the transmission of the red end of the spectrum only, up to the line D, while the second absorbed all light at the ends of the spectrum, allowing only the transmission of the rays between D and F, and the last combination extinguished all rays less refrangible than F. We found the judgment in the case of colored light more difficult and uncertain; the region of equality is distributed over a larger field. There is a remarkable difference between the two observers. For K the greatest average value is found in green, where R has the smallest. If differences in the intensity of our colors, which could not be entirely excluded, were the cause, we should expect another result. If our green was brighter than the two other colors, it should have the smallest average value for both observers. But on the other hand it is quite possible that the same color has different values of intensity for different observers.

By *m. V.* we denote in our tables the mean variation, *i. e.*, the difference between the result of the single series and their average. Where the place for the mean variation is left empty in the tables, the results refer to one series of experiments only.

If we now cast a glance at our tables in order to form an opinion on the bearing of our results, we notice that they differ in two points considerably from those of former investigation. *First*, the minimum point of effectiveness of the light applied to the second eye (or in the terms of Fechner and Aubert, the maximal point of obscuration of the common visual field) is found at higher intensities than by former authors on the subject. *Second*, the phenomenon is greatly dependent on the absolute intensity.

Concerning the first point, it is true we have to assume that we should arrive at lower values for the minimum point, if we should proceed to higher intensities than 360°. We should expect that there is an intensity for which the average value of the point of ineffectiveness would show the ratio 0,122 of the full light, as found by Aubert. Of greater importance is

the second point, the dependence of the phenomenon on the absolute intensity. This dependence presents itself in our table I in such an obvious and regular manner that it is astonishing that it could escape the notice of former investigators. But we must not forget that they worked under entirely different conditions. Also the difference in the results of observer K, for left and right side, may have its cause in the different sensitiveness to light of the two eyes.

Remark on the Foregoing Article.

By A. Kirschmann.

The above reported experiments do not claim to be decisive in so far as concerns the absolute values of the minimal point of efficiency, and it is less the intention of the article to solve the problem definitely than to direct attention again to this subject, which touches so many questions of interest in the psychology of the sense of sight. However, this much may be concluded with certainty from these experiments, namely, that the phenomenon referred to is dependent on the absolute intensity. For small absolute brightness the loss of intensity in binocular vision is comparatively greater than for higher intensities; or in other words, the ratio of apparent intensities of an impression in monocular and binocular vision cannot be considered as constant. A few remarks will perhaps contribute something to the explanation of the paradox trial in particular, and of the problem of the cooperation of the two eyes in general.

What is the paradox in Fechner's experiment? That a decrease of physical intensity is followed by an increase of intensity in sensation. Or, in our special case, that a certain amount of physical intensity, applied to the one retina, has no effect on the total brightness of the binocular impression. But it does not follow from this that it has *no effect at all.* Its effect goes in another direction. The double eye has not the purpose of increasing the total intensity. Its principal function is to accomplish those parallactic relations which serve as the chief means of depth-perception. If to the

image of one eye that of the other is added, the result is something else than a mere summation of intensities. A part of the physical energy which now reaches the two retinæ will be used to accomplish the new result, the creation of a single image and the projection of it into the third dimension. Now since these parallactic relations, which give rise to our depth-perception, are independent of intensity, the energy needed to produce these effects will not be proportionate to the total energy, but it will in all cases demand a certain amount, below which the effect will not be attained.

Let us call the physical intensity which arrives at the one retina i_1, that arriving at the other i_2, and that physical energy which is at least necessary in order to produce the binocular effect x. Now there are three cases possible. If i_1 and i_2 are both greater than x, in the case of binocular combination, the subtraction of the energy, x, which is needed for this effect, will cause a darkening of the binocular visual field, but the brightness will still be greater than either i_1 or i singly. If x is just equal to one of the monocular intensities, the binocular intensity will be equal to the other monocular. The closing of the eye, in which the image had an intensity equal to x, will then cause the vanishing of the binocular space-effect, but without any change in intensity. This is the case where we have just reached the point of inefficiency. Finally, if one of the monocular intensities, say i_2, is smaller than the minimum value of x, the intensity of the binocular impression, when endowed with three-dimensional properties, will be smaller than i_1, because a part of this physical intensity is needed in order to secure the stereoscopic effect, and the exclusion of the second eye will, by setting free again this part of the energy, be followed by an increase of the light intensity. This is the case in Fechner's paradox experiment. This theory would account quite well for the paradox experiment, but it does not for the conjugate intensities. In order to explain this side of the affair, we have to make the additional assumption that in cases where one of the monocular intensities is very small, while the other is comparatively high, the binocular effect is incomplete or vanishes entirely. The works of previous authors are not quite

clear on this point, but it seems to me quite natural that, if to the one eye is applied the intensity 1, to the other the intensity 0,122, or less than that, the stereoscopic effect is lowered or even excluded. After all it is not necessary that the maximal point of obscuration coincide with our point of least effect on the total of visual field. According to the foregoing remarks, it remains, therefore, a problem of further investigation whether or not the paradox phenomenon takes place equally in the case of real binocular combination with three dimensional properties, and in cases of partly co-inciding double-images.

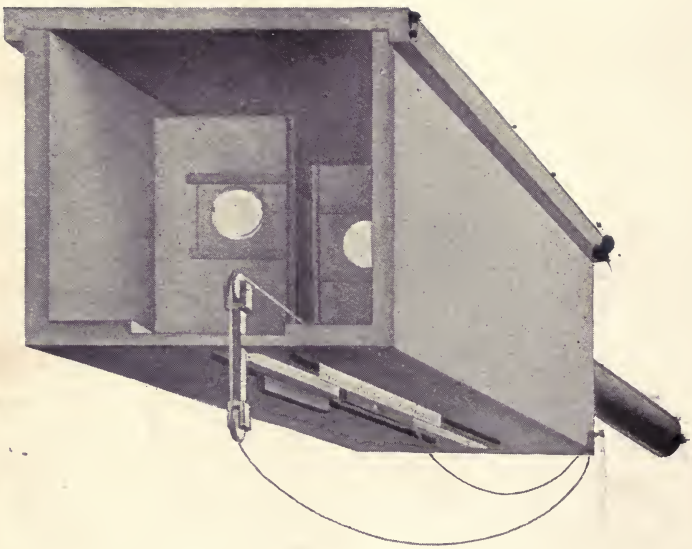
THE INFLUENCE OF THE COLOR OF SURFACES ON OUR ESTIMATION OF THEIR MAGNITUDE.

By J. O. Quantz, B. A.

One of the most generally known optical illusions is the apparently increased diameter of the rising moon. For this phenomenon there are different explanations. It is said that if the moon be near the horizon, we have the opportunity of comparing it with objects at a distance, but well known to us. When the moon is high in the sky, near or at the zenith, —where the diameter is really a little greater, on account of its being nearly 4,000 miles nearer,—we have no such opportunity. This explanation, however, is not satisfactory; for if we see the high-standing moon re-appear behind steep rocks or high buildings, the phenomenon does not occur.

A more satisfactory explanation is this: We project the celestial bodies on the surface of the sky. But the apparent form of the sky is not that of a sphere, but of a flatter vault, like a watch-case. Now, we attribute to all objects which we project on a surface thesize which the corresponding part of the surface itself would have at the distance at which we think we see it.

Whatever the true explanation may be, there is one point which has been overlooked. When the moon appears very large at the horizon, she has always a strongly orange or reddish color. The same is the case with the rising and setting sun; and it can really be observed that the phenomenon is less conspicuous when the reddish color is absent. This, however, does not prove that the redness of the moon is one of the causes of the illusion. The two phenomena may perhaps be traced back to the same cause. It may be, for example, that the moisture of the atmosphere, which causes



the red color by its absorption of the more refrangible rays of light, is also, on account of the dimness in which distant objects appear through it, the cause of our illusion. But it remains a question of interest whether this red color has anything to do with the geometrical optical illusion. From this particular phenomenon arises a more general question: Has the quality of light sensations an influence on the estimation of size? With a view to the solution of this problem, the experiments reported in the following pages were undertaken.

The apparatus used, of which the accompanying figure gives an idea, consisted of a large case, having one end open, and at the other an observing-tube. The case was painted on the inside a dead black to prevent its reflecting light; the tube was covered inside and outside with black velvet. Within this case were two movable black screens in a plane at right angles to the line of vision. Each of these screens was provided with an opening, in order to receive the objects. The latter were diaphragms of thin brass with a circular aperture, behind which were placed gelatine papers of different colors. In order to prevent the light from passing between the screens, the latter were provided at their inside edge with strips of black velvet, which overlapped each other without hampering the movement.

In a few experiments where two white circles were compared, the circles were equal, but for the others unequal; so that when they appeared to be of the same magnitude, they would not be at the same distance from the observer's eye, *i. e.*, not in the same plane. This excluded the possibility of judging the discs to be equal by noticing that they were in the same plane. The right hand diaphragm was stationary, at a distance of 1,240 mm. from the eye of the observer; the left movable, running in a slit in the bottom of the case. This movement, in both directions, was made by means of pulleys at the open end of the case, remote from the observer, and cords attached to both ends of the frame supporting the diaphragm which contained the disc; so that the observer himself was able to regulate the distance. Outside and underneath the case, to admit of being seen without removing the lid, was a millimeter scale, zero being in the plane of the

TABLE I.

Apparent Color.	Composed of		Visible Part of the Spectrum.	Remarks.
	Colored Gelatine Films.	White Tissue Papers.		
Red,	1 purplish red, 1 orange,	1	Red end to 598 $\mu\mu$,	
Orange,	1 rose, 2 orange,	1	696 $\mu\mu$ — 580 $\mu\mu$,	Also weak traces of green near 515 $\mu\mu$.
Yellow,	4 yellow,	1	Red end —509 $\mu\mu$,	Near red end very weak.
Green,	2 green,	1	566 $\mu\mu$ — 512 $\mu\mu$,	
Blue-green,	2 blue, 1 green,	1	556 $\mu\mu$ — 434 $\mu\mu$,	
Blue,	2 blue,	1	536 $\mu\mu$ to the violet end,	
Violet,	2 (different) violet,	1	Whole spectrum visible, with exception of 614 $\mu\mu$ —539 $\mu\mu$,	
Purple,	2 violet, 1 magenta,	1	Red end—600 $\mu\mu$ and 462 $\mu\mu$ —violet end.	Violet end very faint.

fixed disc. The perpendicular part of the sled of the movable object, reaching down a little deeper than the scale, had an arrow-formed white mark, which served as an index. The whole apparatus was placed with the open side against a window with white ground-glass. Fig. 1 shows the arrangement seen from the open side. Each trial consisted simply in changing the position of the left disc to the point at which it *appeared* to be equal in magnitude to the right, and then recording its position. Each color was compared separately with white. A series of trials was made with two white discs to determine what variation might result, which was not due to color.

The quality of the colors used, according to a spectroscopical examination, is shown on the opposite page. The wave-lengths are obtained by graphical interpolation.

The method of calculation may be outlined thus: Figs. 2 and 3 show a horizontal section, Fig. 2 having the larger

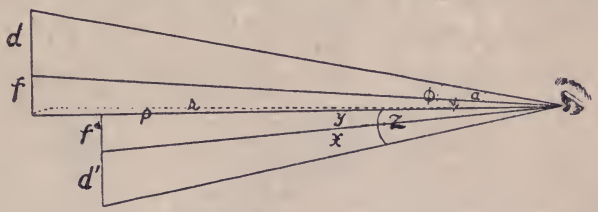


FIG. 2.

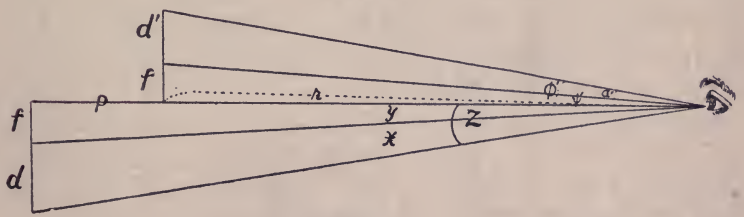


FIG. 3.

circle in the fixed position, and Fig. 3 the smaller. d is the diameter of the larger circle (40.575 mm.); d′ of smaller (36.703 mm.), which is therefore nearer the eye when they appear of equal magnitude; f half distance (19.5 mm.) between the discs; r distance of the eye (1.240 mm.) from the position of the normal disc (stationary at right side); α,

visual angle of larger disc in normal position; a', of smaller; ψ, visual angle of half distance between discs at normal position; $\phi = a + \psi$, $\phi' = a' + \psi$.

a (easily found by trigonometrical calculation by means of the formulæ:

$$\tan\phi = \frac{f+d}{r}$$

$$\tan\psi = \frac{f}{r}$$

$$a = \phi - \psi)$$

For the colors orange, blue-green, violet and purple:

$$a = 1^\circ\,52'\,21''.8$$

Similarly: $a'\,(\phi' - \psi) = 1^\circ\,41'\,39''.2$

The visual angles of the moved object and also the angular value of the mean variation were determined by means of the same formula. If we denote by ρ that distance of the movable object, in which it appears of equal size with the normal disc, by y and z the angular distances of the inner and outer edge of the movable disc from the median line, and finally by x the visual angle of the movable disc, then we have

$$\tan z = \frac{f+d'}{\rho} \text{ resp. } \frac{f+d}{\rho}$$

$$\tan y = \frac{f}{\rho}$$

$$\text{and } x = z - y$$

The angular value of the mean variation has been determined by the following procedure. Suppose the average of the registered values of a series of 50 or 100 single trials (ρ_1, ρ_2, $\rho_3 \ldots \rho_n$) to be ρ_m and the mean variation Δ. Now we compute the visual angle (x) for:

$$\rho = \rho_m$$

$$\rho = \rho_m + \Delta$$

$$\text{and } \rho = \rho_m - \Delta$$

Then the angular value of the mean variation will be

$$\frac{[x\ (\text{for}\,\rho_m + \Delta) - x(\text{for}\,\rho_m)\,] + [x(\text{for}\,\rho_m) - x(\text{for}\,\rho_m - \Delta)\,]}{2}$$

An equal number of trials was made with each eye. Each series of experiments was computed separately, and afterwards combined in tables. The series numbered I to IV under "Division of Experiments," in the subjoined tables, were arranged as follows: In I the colored circle was the

larger, and to the right, *i. e.*, stationary; II, right, and small; III, left, large; IV, left, small. Fig. 2 above thus represents the series I and IV, while Fig. 3 shows the position for II and III. For the colors, red, yellow, blue and green, there were only two divisions corresponding to IV and III respectively, the colored disc being always at the left. The experiments with these colors were made first, in 1893-94; all others were done in 1894-95.

For each series the average distance of the movable (left hand) disc was found, and the visual angle determined and compared with the angle of normal magnitude, *i. e.*, the angle subtending the fixed disc. The results are given under "Average Deviation from Normal Magnitude" in the tabulated statements. *Plus* indicates that the visual angle of the white disc was greater than that of the colored by so much, when they were judged to be equal; *minus*, that it was less; *i. e.*, in those marked *plus*, the color was overestimated, in *minus* it was underestimated.

In all the observations care was taken to exclude from the eye other light than that which entered through the observing-tube. The intensity of light was slightly greater on certain days than on others. But this made no appreciable difference in results, as was proved by a set of experiments undertaken for the purpose, with different light-intensities. Also the intensity-relation between the colored and uncolored disc was changed in order to see its influence on the judgment. The result was negative. There was made, *e. g.*, for the color blue, one series where the colored disc was compared with a white, composed of three tissue papers; while in an other series the white consisted of four tissue papers. The difference between the two series was smaller than the mean variation. This proves that irradiation and small differences in the relative light-intensities have under such circumstances, where bright objects are seen before an entirely dark background, no effect on the estimation of surface-magnitude. But after all, we chose our intensities as near to equality as it is possible to get them by comparison of differently colored surfaces in transmitted light. The two observed circles were exactly on a level with, each other to prevent the possibility

of one being enlarged by occupying a higher position, and being thus projected on a different retinal region. The difference in lateral indirect vision, too, was almost entirely excluded, by the circles being placed equally distant to the right and the left of the centre of vision. The trials were made throughout with the movable disc advancing and receding alternately, so that any possible error from this source was ruled out.

The tabulated results follow in Tables II-X (pages 33 to 38).

The conclusions previously reached were modified by an unexpected discovery, viz., that the moved circle was always underestimated. This is confirmed, too, by the trials in which both discs were white, the movable one, in order to appear equal to the other, requiring a visual angle greater by 28″.7 to 4′ 58″.8, and only in one instance less, and then but 5″.5. On an average the moved disc was underestimated by K. 1′ 31″.8, and by Q. 2′ 28″.8875. We found also, on thinking back, that the experimenter had in almost every case stopped, after judging the circles to be equal while slowly moving the one, and then observing them at rest was not satisfied with their equality, and again changed their relative positions a little. The underestimation of the surface-magnitude of a bright object on dark ground seems according to our experiments beyond all doubt. It is not the place here to enter on a further discussion of this phenomenon, the examination and explanation of which remain a subject for later investigation.

This consideration ought not to affect the total average with the colors where half the trials were made with the white disc moved (orange, blue-green, violet, purple); but with red, yellow, green and blue, the white was always at rest. Making the allowance which the trials with the two white circles indicate, *i. e.*, taking into account the average underestimation of the moved disc, and computing after this modification the ratios of the over or underestimation of the colored objects to the normal magnitudes, we arrive at the results in Table XI.

It may be of some interest also to compare the accuracy of the judgment for the different colors. For this purpose we

TABLE II.—*White.*

Division of Exps.	OBSERVER, DR. KIRSCHMANN.						OBSERVER, J. O. QUANTZ.					
	LEFT EYE.			RIGHT EYE.			LEFT EYE.			RIGHT EYE.		
	No. of Single Exp.	Av. Deviation from Norm. Mag	M. V.	No. of Single Exp.	Av. Deviation from Norm. Mag	M. V.	No. of Single Exp.	Av. Deviation from Norm. Mag	M. V.	No. of Single Exps.	Av. Deviation from Norm. Mag	M. V.
		° ′ ″	′ ″		° ′ ″	′ ″		° ′ ″	′ ″		° ′ ″	′ ″
Equal Discs	50	+0 2 8.7	1 14.92	50	+0 1 10.2	0 40.73	50	+0 0 46.55	0 34.9	50	+0 0 28.7	0 57.05
Unequal Discs	50	+0 2 53.8	1 41.8	50	−0 0 5.5	1 19.25	50	+0 4 58.8	1 16.65	50	+0 3 41.5	1 22.28
Av. for Single Eyes	100	+0 2 31.25	1 28.36	100	+0 0 32.35	0 59.99	100	+0 2 52.68	0 55.78	100	+0 2 5.1	1 9.66

	No. of Single Trials.	Average Deviation.		M. V.	No. of Single Trials.	Average Deviation.		M. V.
		Absolute Value.	Val. Rel. to Norm. Mag.			Absolute Value.	Val. Rel. to Norm. Mag.	
		′ ″		′ ″		′ ″		′ ″
Total Average	200	+1 31.8	+0.01355	1 14.18	200	+2 28.89	+0.0221	1 2.72

TABLE III.—*Red.*

Division of Exps.	OBSERVER, DR. KIRSCHMANN.								OBSERVER, J. O. QUANTZ.							
	LEFT EYE.				RIGHT EYE.				LEFT EYE.				RIGHT EYE.			
	No. of Single Exp.	Av. Deviation from Norm. Mag.		M. V.	No. of Single Exp.	Av. Deviation from Norm. Mag.		M. V.	No. of Single Exp.	Av. Deviation from Norm. Mag.		M. V.	No. of Single Exp.	Av. Deviation from Norm. Mag.		M. V.
		° ′ ″		′ ″		° ′ ″		′ ″		° ′ ″		′ ″		° ′ ″		′ ″
Red, Small,	25	—0	0 15.84	0 43.08	25	+0	1 26.11	1 6.45	55	—0	3 50.39	1 43.85	55	—0	2 28.74	1 22.20
Red, Large,	25	+0	0 2.44	1 29.	25	+0	3 33.24	1 8.2	50	—0	0 27.34	1 16.	50	+0	0 22.38	1 21.8
Av. for Single Eyes,	50	—0	0 6.70		50	+0	2 29.67		105	—0	2 8.86		105	—0	1 3.18	

TABLE IV.—*Yellow.*

Yellow, Small,	50	—0	2 27.71	1 35.02	50	+0	0 13.70	1 7.38	50	—0	4 1.23	0 55.4	50	—0	2 58.56	1 17.5
Yellow, Large,	50	—0	1 6.17	1 19.8	50	+0	1 7.27	1 15.73	50	—0	1 24.81	1 12.25	50	+0	0 5.16	1 19.85
Av. for Single Eyes,	100	—0	1 46.94		100	+0	40 48.77		100	—0	2 43.02		100	—0	1 26.70	

TABLE V.—*Green.*

Green, Small,	50	—0	3 57.26	1 52.27	50	—0	0 30.31	1 10.75	50	—0	2 51.86	1 33.8	50	—0	2 26.69	1 11.
Green, Large,	50	—0	4 43.76	1 43.15	50	—0	1 51.11	1 10.31	50	+0	0 7.91	0 57.93	50	—0	0 5.93	1 4.75
Av. for Single Eyes,	100	—0	4 20.51		100	—0	1 10.71		100	—0	1 21.97		100	—0	1 16.31	

TABLE VI.—*Blue.*

Blue, Small,	50	—0	4 35.03	1 23.05	50	—0	2 29.17	1 8.85	50	—0	3 13.23	1 19.29	50	—0	3 59.85	1 14.85
Blue, Large,	50	—0	5 45.07	1 34.93	50	—0	1 48.41	2 12.05	50	—0	1 58.14	1 13.	50	—0	0 55.08	1 41.3
Av. for Single Eyes,	100	—0	5 10.05		100	—0	2 8.79		100	—0	2 35.68		100	—0	2 27.46	

TABLE III.—*Red.*

	No. of Single Trials.	Average Deviation.		M. V.	No. of Single Trials.	Average Deviation.		M. V.
		Absolute Value.	Val. Rel to Norm. Mag.			Absolute Value.	Val. Rel. to Norm. Mag.	
		′ ″		′ ″		′ ″		′ ″
Total Average,	100	+1 11.49	+0.0117	1 6.68	210	—1 36.02	—0.0155	1 25.96

TABLE IV.—*Yellow.*

Total Average,	200	—0 33.23	—0.0053	1 19.48	200	—2 4.86	—0.0201	1 11.25

TABLE V.—*Green.*

Total Average,	200	—2 45.61	—0.0269	1 29.12	200	—1 19.14	—0.0127	1 10.87

TABLE VI.—*Blue.*

Total Average,	200	—3 39.42	—0.0356	1 34.72	200	—2 31.57	—0.0245	1 22.11

TABLE VII.—*Orange.*

Division of Expers.	OBSERVER, DR. KIRSCHMANN.									OBSERVER, J. O. QUANTZ.								
	LEFT EYE.				RIGHT EYE.					LEFT EYE.				RIGHT EYE.				
	No. of Single Exp.	Av. Deviation from Norm. Mag.		M. V.	No. of Single Exp.	Av. Deviation from Norm. Mag.		M. V.		No. of Single Exp.	Av. Deviation from Norm. Mag.		M. V.	No. of Single Exp.	Av. Deviation from Norm. Mag.		M. V.	
		°	′	′ ″		°	′	′ ″			°	′	′ ″		°	′	′ ″	
I. Right, Large,	25	+0	9	3.95 1 38.25	25	+0	6	26.94 1 44.18		25	+0	3	43.95 1 27.05	25	+0	2	54.1 1 13.15	
II. Right, Small,	25	+0	6	41.8 1 13.28	25	+0	4	1.95 1 18.44		25	+0	1	37.3 1 19.75	25	+0	1	25.6 0 59.05	
III. Left, Large,	25	—0	0	16.26 0 55.8	25	+0	2	11.95 1 7.58		25	—0	0	48.5 0 59.78	25	+0	0	40.9 1 0.85	
IV. Left, Small,	25	—0	0	37.3 1 23.63	25	+0	3	16.9 1 10.25		25	—0	4	32.95 1 16.68	25	—0	2	29.25 1 16.35	
Av. for Single Eyes,	100	+0	3	43.05 1 17.74	100	+0	3	59.44 1 20.11		100	—0	0	0.05 1 15.81	100	+0	0	37.84 1 6.85	

TABLE VIII.—*Blue-Green.*

I	25	+0	4	24.7 1 17.23	25	—0	0	1.8 1 24.7		25	+0	3	13.85 1 37.3	25	+0	1	2.2 1 23.78	
II	30	+0	4	9.8 1 6.95	30	+0	0	36.8 1 37.78		30	+0	0	50.4 1 1.4	30	—0	0	35.55 1 3.88	
III	25	—0	6	40.4 1 20.4	25	—0	4	34.4 1 22.2		25	—0	0	22.5 1 43.58	25	—0	0	28.9 1 23.05	
IV	25	—0	6	10.8 1 23.8	25	—0	3	28.35 2 10.53		25	—0	2	59.1 2 1.	25	—0	2	13.65 1 33.08	
Av. for Single Eyes,	105	—0	1	4.18 1 17.10	105	—0	1	51.94 1 38.80		105	+0	0	10.66 1 35.82	105	—0	0	33.98 1 20.95	

TABLE IX.—*Violet.*

I	25	+0	3	12.1 1 46.5	25	+0	1	11.25 1 34.75		25	+0	3	2. 0 55.70	25	—0	0	1.8 1 33.63	
II	25	+0	3	34.4 1 8.38	25	+0	1	56.3 0 54.36		25	+0	0	13.1 0 51.55	25	—0	0	39.15 1 20.93	
III	25	—0	7	5.45 1 1.75	25	—0	5	4.35 1 24.7		25	—0	1	2.77 1 4.25	25	—0	0	13.55 1 1.7	
IV	25	—0	5	39.5 1 16.33	25	—0	3	27.1 1 55.93		25	—0	4	35.6 1 39.93	25	—0	3	34.5 1 15.	
Av. for Single Eyes,	100	—0	1	29.61 1 18.24	100	—0	1	20.98 1 27.43		100	—0	0	35.82 1 7.86	100	—0	1	7.25 1 17.81	

TABLE VII.—*Orange.*

	No. of Single Trials.	Average Deviation.			M. V.		No. of Single Trials.	Average Deviation.			M. V.	
		Absolute Value.		Val. Rel. to Norm. Mag				Absolute Value.		Val. Rel. to Norm. Mag.		
		°	′	″	′	″		°	′	″	′	″
Total Average,	200	+0	3	51.24	+0.0358	1 18.92	200	+0	0	37.79	+0.0031	1 11.33

TABLE VIII.—*Blue-Green.*

Total Average,	210	—0	1	28.06	—0.0138	1 27.95	210	—0	0	11.66	—0.0018	1 28.38

TABLE IX.—*Violet.*

Total Average,	200	—0	1	25.29	—0.0134	1 22.84	200	—0	0	51.53	—0.00785	1 14.75

TABLE X.—*Purple.*

Division of Exps.	OBSERVER, DR. KIRSCHMANN.								OBSERVER, J. O. QUANTZ.							
	LEFT EYE.				RIGHT EYE.				LEFT EYE.				RIGHT EYE.			
	No. of Single Exp.	Av. Deviation from Norm. Mag.		M. V.	No. of Single Exp.	Av. Deviation from Norm. Mag.		M. V.	No. of Single Exp.	Av. Deviation from Norm. Mag.		M. V.	No. of Single Exp.	Av. Deviation from Norm. Mag.		M. V.
		° ′ ″		′ ″		° ′ ″		′ ″		° ′ ″		′ ″		° ′ ″		′ ″
I	50	+0	8 2.1	1 39.9	50	+0	5 45.	1 33.	50	+0	4 41.	1 15.	50	+0	3 10.1	1 24.35
II	50	+0	3 12.9	0 53.9	50	+0	1 27.6	0 35.9	50	+0	1 34.8	1 13.5	50	+0	0 19.6	1 7.45
III	50	−0	5 35.6	1 4.55	50	−0	3 19.9	1 17.5	50	−0	0 45.5	1 43.3	50	+0	0 32.6	1 44.6
IV	100	−0	3 39.98	1 43.55	100	−0	1 9.85	1 38.91	100	−0	3 17.65	1 26.33	100	+0	0 34.85	1 20.41
Av. for Single Eyes,	250	+0	0 29.85	1 20.48	250	+0	0 40.71	1 16.33	250	+0	0 33.16	1 24.53	250	+0	1 9.29	1 24.20

	No. of Single Trials.	Average Deviation.		M. V.	No. of Single Trials.	Average Deviation.		M. V.
		Absolute Value.	Val. Rel. to Norm. Mag.			Absolute Value.	Val. Rel. to Norm. Mag.	
		° ′ ″		′ ″		° ′ ″		′ ″
Total Average,	500	+0 0 35.28	+0.0045	1 18.40	500	+0 0 51.23	+0.0078	1 24.37

TABLE XI.

COLOR.	OVER- OR UNDER-ESTIMATION, RATIO TO THE NORMAL MAGNITUDE.	
	Observer K.	Observer Q.
Red,	+0.02525	+0.0066
Orange,	+0.0358	+0.0031
Yellow,	+0.00825	+0.0020
Green,	—0.01335	+0.0094
Blue-green,	—0.0138	—0.0018
Blue,	—0.02205	—0.0024
Violet,	—0.0134	—0.00785
Purple,	+0.0045	+0.0078

TABLE XII.

COLOR.	OBSERVER K.		OBSERVER Q.	
	AVERAGE MEAN VARIATION		AVERAGE MEAN VARIATION.	
	Absolute Value.	Ratio of the Normal Magnitude	Absolute Value.	Ratio of the Normal Magnitude
Red,	1′ 6″.681		1′ 25″.9625	
Orange,	1′ 18″.92375		1′ 11″.3306	
Yellow,	1′ 19″.481		1′ 11″.25	
Green,	1′ 29″.1225		1′ 10″.87	
Blue-green,	1′ 27″.9481		1′ 28″.38375	
Blue,	1′ 34″.719		1′ 22″.111	
Violet,	1′ 22″.835		1′ 14″.7469	
Purple,	1′ 18″.4016		1′ 24″.3672	
Av. of all Colors,	1′ 22″.264	0.0131 (= ca. $\frac{1}{76}$)	1′ 18″.6278	0.0125 (= ca. $\frac{1}{80}$)
White,	1′ 14″.175	0.0110	1′ 2″.71875	0.0093 (= ca. $\frac{1}{108}$)

have in Table XII placed together the average mean variations, which remain without exception between the limits of 1′ and 1½′. The accuracy in case of the comparison of two white discs is only very little greater than that of the comparison of a colored disc with a white one. Among the 104 series of experiments there are only three cases where the m. V. is greater than 2′, and fifteen cases where it amounts to less than 1′. The greatest value for the m. V. occurred in the experiments with blue (Observer K.), and amounts to 2′ 12″.05, which corresponds to a relative value of 0.0216 of the normal magnitude. The smallest m. V. we find in the experiments with purple = 35″. 9, that is, 0.0059 of the normal magnitude, or a little more than the smallest visual angle which can be perceived in colored light.[1] It may be remarked here, that everywhere in our tables, where we give the average in minutes and seconds, these absolute values contain a certain small inaccuracy, because the averaged values refer to different normal magnitudes. (For the colors red, yellow, green and blue, the normal magnitudes are 6227″.3 and 6106″; for the other colors they are 6741″.8 and 6099″.3; in the case of two white discs the normal magnitude was always 6741″.8.) In the relative values reported in our tables, this inaccuracy is eliminated.

If we review the results of our investigation in the condensed form given in Tables XI and XII, we are able to draw the following conclusions concerning the influence of the quality of light-sensation on the estimation of surface magnitudes:

There is a small, but decided, influence of color. Red, orange, yellow and also purple have been overestimated by both observers, while blue-green, blue and violet show a decided underestimation. The color of the middle of the spectrum only, green, has different effects on the two observers. The over and underestimation respectively, although they may take part in causing optical illusions, are not con-

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[1] Uhthoff, "Ueber die kleinsten wahrnehmbaren Gesichtswinkel in den verschiedenen Theilen des Spektrums." *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, B. I, p. 155 ff.

siderable enough to explain a phenomenon like that of the rising moon. They are indeed very small, varying between the limits of $\frac{1}{28}$ and $\frac{1}{220}$ of the normal magnitude for the Observer K., and $\frac{1}{1060}$ to $\frac{1}{560}$ for the Observer Q. But they present themselves with a marked regularity and constancy, and with a decided coincidence of their direction in the results of the two observers.

In order to secure the commensurability of the results for the different colors, it was necessary to apply for all colors approximately the same normal magnitude, which was less than 2° (= about 4 diameters of the full moon) and more than $1\frac{1}{2}$° (or about 3 diameters of the moon). It is possible that the over or underestimation would be found to be more considerable in case of smaller normal magnitudes.

Résumé.

I. When colored surfaces of moderate size are seen on a darker background, the colors of the less refrangible part of the spectrum, and also reddish purple, show a decided tendency towards overestimation in space-extension, while for the more refrangible colors of the spectrum a marked underestimation takes place.

II. Our judgment of the equality of surface-magnitudes shows a rather high degree of accuracy, which is for white but little greater than for colored surfaces.

III. White or colored surfaces of moderate size, seen on a dark background, are underestimated in size when seen in motion towards or from the eye.

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF CORNELL UNIVERSITY.

COMMUNICATED BY E. B. TITCHENER.

XI.—SOME QUESTIONS OF THE CUTANEOUS SENSIBILITY.

BY W. B. PILLSBURY, A. B.

INTRODUCTION.

This article gives the results of a series of experiments made during the academic year 1893-94, at the Cornell Psychological Laboratory. The method employed was the second of those used by E. H. Weber in his classic investigation of cutaneous space relations. A point on the skin was touched and the subject requested to indicate the point stimulated as accurately as possible. The average error of such attempts at localization afforded a relative measure of the space sensibility of the skin. Weber himself considered this average error an absolute measure of the local sensibility of the part of the skin worked upon. He says: "Bestimmt man mit einem Zirkel und Maasstabe wie weit der Beobachter von dem gesuchten Orte entfernt bleibt, wenn er demselben am nächsten zu sein glaubt, und nimmt aus vielen solchen Bestimmungen das Mittel, so wird man finden, dass es desto weiter von ihm entfernt bleibt je unvollkommener der Raumsinn in dem Theile der Haut ist an welchem der Versuch gemacht wird.[1]"

1. Czermak objected that this average error must be in every case too small, and therefore rejects the method entirely. He says:[2] "Bei dieser Bestimmung spielt der Zufall eine so bedeutende Rolle dass der Werth des ganzen Verfahrens zur Ermittlung der Feinheitsgrade des Raumsinnes in Frage gestellt wird. * * * Hier hilft es auch

[1]Ueber den Raumsinn, pp. 89-90. In the *Verhandlungen d. k. sächsischen Gesellschaft d. Wissens. in Leipzig. Math.-phys. Classe*, 1852.

[2]Physiologische Studien, 2te Folge, pp. 52-53.

nicht das Mittel aus vielen Beobachtungen zu ziehen, da die Bestimmungen in überwiegender Zahl zu klein sind, das Mittel daher auch zu klein ausfallen muss. Bei dem Verfahren mit dem Zirkel ist die Bestimmung durch zwei Grenzwerthe, einen kleinsten und einen grössten beschränkt, während bei diesem Verfahren nur der eine und zwar der grösste Grenzwerth nicht überschritten werden kann, indem es für dieses Verfahren gar keinen kleinsten Grenzwerth gibt. Der kleinste Grenzwerth ist hier = 0, wenn nämlich die suchende Sonde zufällig die zuerst berührte Hautstelle findet. * * * Aus dem gesagten ergibt sich nun von selbst dass das zweite Weber'sche Verfahren zur genaueren Bestimmung der Feinheit des Raumsinnes in der Haut gänzlich unbrauchbar sei."

In his statement of the facts, Czermak is unquestionably correct. The average error will necessarily be smaller than the limen of twoness. But his conclusion that the method is for this reason useless is not so unexceptionable. For, although itself too small, the error must nevertheless bear a constant and mathematically determinable relation to the limen. It is plain that within the figure formed by the limen, one point would be hit upon as often as any other in an infinite number of experiments. Within the limen there is no diverting agency which would tend to favor one point rather than any other. All would be determined by the laws of chance. The case is not analogous to that of shots fired at a target, where there is a conscious endeavor to hit the centre. For the consciousness of the subject, the figure bounded by the limen is a mathematical point. Centre and circumference are one for him. Consequently, his attempt to touch the figure bounded by the limen has no effect in directing a point towards the centre rather than towards any other point within its area.—It might be supposed, on the other hand, that the periphery would be favored; approach being usually made from the outside. But the localization is frequently made from above, and at the first attempt. Even when a point outside the limen is first touched, and the correction made by moving along the surface, the exploring pencil generally moves around in all directions in the neighborhood of the point sought, and often finally stops only on the far side of it. This lack of directing agency is not only theoretically demonstrable, but is proved by an examination of our results.[1]

If we should average the errors made on every radius of the

[1] The absence of preference of the periphery in this context of *amount* of localization error does not, of course, conflict with the tendency to localize in a certain *direction*, noticed below.

figure formed by the limen, and plot on the radii the averages thus obtained, we should have a line bounding a figure similar to that bounded by the limen and dividing the area of the limen into equal parts. This line of average error would, *i. e.*, contain the same area within it as was contained between it and the limen. By the law of similar figures, the distance from the point touched to any point on the line of average error would be to the distance from the same point to the corresponding point on the limen as 1 to $\sqrt{2}$. From this it is evident that the mean error of localization can be used as a measure of discrimination for the comparison of different points of the skin; and its reduction (multiplication by $\sqrt{2}$) will give a value comparable with the value of the limen as determined by other methods. This, then, is one of the points to which we desire to call attention in the present investigation.

2. Another of the principal objects of the investigation was the determination of the part played in localization by the visual image, which the reagent *Wn.*[1] had already found to be an important factor in all cutaneous space judgments. To obtain this a number of series were made with the subject localizing so far as possible in terms of tactual sensations alone, followed by a number of series in which as much prominence as possible was given to the visual image. In order still further to increase the prominence of the visual image, the person experimented upon, during series of a third type, kept the eyes open and fixed on the arm during the application of the pressure, and then closing the eyes localized as before.

3. A third problem was the testing of the results obtained with the photograph-method of Henri. In this the subject localized the point touched upon a photograph of the arm instead of upon the arm itself. Here again we find the visual image playing an important rôle, but under several new and complicating influences.

Experiments.

Our investigation was restricted to an area of the volar side of each forearm, extending from the folds of the skin at the base of the palm to a point some nine centimeters up the arm towards the elbow. This area was subdivided into twelve by two longitudinal and three horizontal lines. Only one experiment was made on each of these parts during a single

[1] *Ueber den Einfluss der Gesichtsassociationen auf die Raumwahrnehmungen der Haut. Phil. Stud. XI, 2.* As Miss Washburn's paper is logically prior to the present, the latter has been withheld from publication until the appearance of the *Studien.*

experimental series, as it was found that the after-effect of pressure exerted a disturbing influence upon judgment. It was often noticed during the first few days of experimentation, when this point had not been observed, that the after-effect of a preceding experiment was mistaken for the impression given to be localized. Even when this mistake was not made, the subject was conscious of a confusion due to the same cause.

During experimentation the reagent sat with eyes closed or open, as the method required, the arm resting comfortably on a table. The experimenter touched a point on the skin with a charcoal point; the reagent indicated the point touched with another and similar charcoal point. The error made in this localization was then measured with a compass and scale. Care was taken that the charcoal points should be of the same size—one millimeter in diameter. Record was made both of amount and direction of error. The directions were divided into eight groups, for convenience of record: right (R.), left (L.), peripheral or towards wrist (P.), central or towards elbow (C.), and the directions midway between these: *L. P.*, *R. P.*, *L. C.*, and *R. C.* The subjects were Miss Washburn (*Wn.*), Messrs. Knox (*K.*), Read (*R.*), Titchener (*T.*) and Watanabe (*We.*). With the exception of *R.*, all had had experience in experimental work, and all the rest except *K.* in experiments on this same portion of the arm.

All methods of collecting the results from a limited number of experiments are liable to objection. Two methods of massing the experiments from different positions are open to us. The results may be averaged, each result counting for one, without reference to the position of stimulation; or the average may be obtained for each position and then the average values of the various positions averaged. The first method may be very unfair to some particular position, since the errors are determined in their position by chance, and the sensibility of the skin is very different for different positions. There might, for instance, be a large proportion of all the errors towards the wrist (*P.*) made at some point of great sensibility. If averaged directly, the value for *P.* in the given case would be much too small. This objection would, of course, hold against any method of determination in which care was not taken that an equal number of experiments were made on each portion of the part of the skin which was being investigated. The other method allows the fewer experiments equal weight with the larger number, and in a very limited number of experiments may give rise to serious errors. These, however, are at most chance errors, and will

disappear with an increase in the number of observations. As the lesser of the two evils, we have chosen the latter method of 'massing.'

1. The results obtained from two reagents in one investigation of the *effect of visualization*, massed as explained above, are given in Table I.

TABLE I. *Unit = 1 mm.*

Reagent T.			*Reagent Wn.*		
Without Viz.	With Vis.	Eyes Open.	With't Vis.	With Vis.	Eyes Open.
7 Series. 168 Ex.	7 Ser. 168 Ex.	8 Ser. 192 Ex.	19 Ser. 456 Ex.	19 Ser. 456 Ex.	20 Ser. 480 Ex.
P. = 8.35	4.09	3.95	4.26	4.56	3.03
C. = 8.59	4.76	5.20	4.76	5.03	2.84
R. = 6.65	2.45	3.18	2.28	3.52	2.35
L. = 7.57	5.11	3.27	3.38	3.49	2.62
R. P. = 6.78	4.80	4.49	4.10	5.19	3.00
L. P. = 6.88	4.92	5.28	3.03	3.58	3.79
R. C. = 9.03	5.28	4.78	5.03	4.62	2.78
L. C. = 7.13	6.88	5.14	5.21	2.95	2.74
60.98	38.29	34.39	32.37	32.94	23.15

We give only the results from *T.* and *Wn.* All the others show the same tendencies as *Wn.* The sums of all the errors are given merely for convenience, this appearing the best means of showing at a glance the relations between the different series. Nothing is claimed for them as averages.

In the case of every reagent the experiments of the first seven or eight days were disregarded, so that practice may be considered constant throughout the entire table. The series of each day was not long enough to give rise to fatigue. The experiments seldom required more than half an hour a day.

The results show that none of the reagents, with the exception of *T.*, were able voluntarily to control *visualization.* All, during the experiments themselves, frequently said that they found it impossible to shut out the visual image, and

their results show no difference between the experiments performed with and without visualization. *T.*, however, found it possible to exclude the visual image to a large extent, was positive of the fact as indicated by introspection during the observations, and shows in his results a very marked difference between the two methods.

2. As regards the influence of *position*: we find the longitudinal divisions to be about on a par, so far as can be decided from the experiments performed. Right, left and centre of the wrist seem to show an equal error. In several cases there was an indication of a slight superiority on the outside of the arm, *i. e.*, the right side of the right arm and the left side of the left; but the results are not concordant enough to be decisive on this point.

The differences between the horizontal divisions are more striking, as will be seen by a glance at Table II. In this table the Roman figures designate the distance from the base of the palm at which the observations were made; I. beginning at a distance of approximately 9cm., and the others approaching the palm by stages of about 3cm. Absolute exactness of stimulus position is not claimed, but the variation did not exceed $\pm$ 2.5 mm.

The first quantity at the foot of the column gives the sum of the errors in the position. It affords a good indication of the gradual decrease of the error as the wrist is approached. The second figure shows the relation between the horizontal and the vertical errors. In this fraction the numerator represents the horizontal, the denominator the vertical errors.

There are several exceptions to the general rule of the increase of the ratio between horizontal and vertical errors as the wrist is approached, but such exceptions are not more numerous than would be expected with such a small number of results.

Only selected results are given, to avoid too great length. The series chosen were from the more experienced subjects, and are those which include the greatest number of experiments. Where other means of preference were lacking, results were chosen that fairly represented the whole number. There is only one exception to the general law of the relation between horizontal and vertical errors, and none to the tendency to decrease toward the wrist, in the series of results not given.[1]

In this table we see a constant decrease in the size of the error as we go toward the wrist. The greatest difference is either between the series taken near the base of the hand, on

[1] No. of series published = 6. No. of series not published = 3.

TABLE II. *Unit = 1 mm.*

Reagent T.

WITH VIS. 7 Series. 168 Experiments.				EYES OPEN. 8 Series. 192 Experiments.			
I.	II.	III.	IV.	I.	II.	III.	IV.
P.=5.83	4.54	4.84	2.00	6.28	5.19	3.06	2.49
C.=5.84	6.85	3.25	3.72	7.38	6.09	3.84	3.00
R.=1.00	3.45	2.62	3.39	2.97	3.67	3.02	2.79
L.=3.13	3.75	4.50	3.75	Lacking	1.95	3.00	3.30
R.P.=4.00	4.00	6.50	5.15	5.32	3.75	Lacking	3.00
R.C.=6.08	4.15	5.13	Lacking	7.00	3.75	4.00	5.25
L.P.=4.50	5.63	5.00	"	8.63	5.17	3.22	5.13
L.C.= 10 25	6.17	7.38	3.50	3.00	5.63	4.10	4.00
41.03	38.54	39.22	29.02[1]	46.37[1]	35.20	27.70[1]	28.96
Ratio: 0.3530	0.6321	0.8801	1.2518	0.4349	0.4982	0.8725	1.1109

Reagent R. *Reagent We.*

EYES OPEN. 7 Series. 168 Experiments.				NORMAL. 13 Series. 312 Experiments.			
I.	II.	III.	IV.	I.	II.	III.	IV.
P.=5.20	5.56	4.33	1.70	9.67	8.13	6.26	5.75
C.=5.36	4.54	4.50	2.25	4.25	4.25	4.63	1.88
R.=7.25	2.00	2.33	1.50	5.42	5.32	3.03	2.69
L.=4.25	4.13	5.00	1.23	6.00	5.14	5.09	4.84
R.P.=4.50	3.25	5.67	5.00	8.63	7.13	7.50	6.75
R.C.=8.00	4.37	1.00	4.75	7.00	5.00	4.50	4.10
L.P.=5.84	7.25	3.50	3.50	8.75	6.17	6.70	3.54
L.C.=5.50	Lacking	4.50	3.45	7.15	7.09	4.00	4.80
45.90	35.55[1]	30.83	25.38	56.81	48.23	41.71	34.40
Ratio: 1.0890	0.6069	0.8301	0.6963	0.8204	0.8449	0.7457	09.934

[1]The directions lacking are supplied by the average value.

Reagent Wn.

Without Vis. (Theoretically.) 19 Series. 456 Experiments.				Eyes Open. 20 Series. 480 Experiments.			
I.	II.	III.	IV.	I.	II.	III.	IV.
P.=5.17	3.89	3.89	3.47	4.32	3.68	2.95	1.72
C.=5.10	4.15	4.68	3.27	3.50	3.84	3.18	1.84
R.=2.50	1.12	4.64	2.83	3.89	1.38	2.00	1.96
L.=3.92	3.39	4.59	2.17	2.44	2.14	3.09	2.36
R.P.=3.09	5.03	3.38	3.34	4.00	2.75	1.24	2.07
R.C.=5.26	5.27	5.50	4.00	2.50	1.63	3.00	4.50
L.P.=3.43	4.60	4.04	2.94	4.50	4.34	2.23	2.03
L.C.=6.83	6.07	4.76	3.17	2.25	3.55	2.38	2.00
35.30	33.52	35.48	25.19	27.40	23.31	20.37	18.68
Ratio: 0.5278	0.5609	1.0770	0.7418	0.8095	0.4681	0.8303	1.2135

the folds of the skin at the joint, and the other three; or between the two upper and the two lower sets of observations. This difference is due, at least in part, to individual variations in the distance from the hand to which the folds extend. Not only does the size of the error decrease as the folds of the wrist are approached, but the form of the figure constituted by the limen changes in a marked degree. On the parts of the arm nearer the elbow, the longer axis of the ellipse formed by the limen is vertical; on the folds of the skin at the joint, the horizontal axis bears a much larger proportion to the vertical axis, and in some cases becomes the long axis of the figure.

This change of direction seems in some way connected with the direction of the prominent markings, cords or folds, on the surface of the skin. The greatest error is made in the direction of such markings. That is, the greatest error is longitudinal on the higher parts of the arm, while near the base of the palm, where the folds also enter as prominent visual landmarks, we find the horizontal errors increase and in some cases become predominant in the final result. Moreover, during an experiment the reagent was often con-

scious of localizing by means of the image of the cords or folds. In several cases where an unusually large error was made, he would remark that it was 'on the same cord,' without knowing that the error made was exceptional. In a few instances it was found that one cord was mistaken for another.

The most obvious explanation is to be given in terms of the effect of visualization. The 'local signs' of the skin seem to be translated by association into terms of the visual image, and the localization made by means of a second association with the local signs. The experiment seems to be a search for a sensation of the same local sign as the original sensation. In this search the observer is first, and, in a general way, assisted by the association formed with the visual image, and through this with the appropriate motor sensation. As the exploring point touches the skin the local signs call up the associated visual image in terms of which, principally, the direction of the error is noted and the necessary corrections made. When a local sign and its associated visual image coincide with the local sign and visual image originally given, and for which the observer is seeking, the localization is considered as complete. In most cases, however, the local sign is to a great extent lost sight of, and the comparison takes place almost wholly in terms of the visual image alone. In such cases one would expect the result found in the experiments, that similarity in visual form should be accepted as identity in position. The great aid rendered by the visual image was noticed and frequently remarked upon by the reagents. They declared that they saw the point touched upon a mental visual image and used this image as a chart in their localization.

Another possible hypothesis might ascribe to the form of the surface a power of affecting the character of local signs. This would necessarily be in terms of the effect of physical structure on the transmission of the mechanical stimulus from the point touched to the nearest end-organs of touch. But the effect on the nerve endings could only be to give a difference in intensity, not in quality, and it seems impossible to frame a schema in accordance with which such delicate distinctions could be made by an organ of such comparatively gross sensibility.

3. In Table III. we give the average error, corrected as explained at the beginning of this article, for the error due to chance, *i. e.*, *the value of the localization limen*. The values for the upper part of the arm and for the folds of the skin are given separately. During the first experiments, no record was kept of the part of the wrist on which the error was made. For these series the average for the whole area of

skin investigated is given (column 3). In making the correction, only 1.4 of the value of $\sqrt{2}$ is used, as giving a sufficiently accurate result.

Throughout the Table, the Roman figures, as before, show the distances above the wrist at which the series were taken. I. is nearest the elbow, (about 9 cm. above the base of the palm); the others are successively 3 cm. farther from it.

The relatively small value of the limen, as determined by this method, must be in part due to the fact that the exploring point is moving over the skin, in part to the better attention of the reagent assured by the movements he must make, and in part to the additional aid rendered by associated movement sensations.

The increase of the error during visualization in *We.'s* results was probably due to the disturbing effect of introspection, and the attempt at control. It is to be noticed that in his case it is a comparison of normal localization, without regard to the visual image, and attempted visualization. With the other reagents there is an effort to visualize or not to visualize in the two series.

TABLE III.

	Unit = 1 mm.	Mas'd I-III.	IV.	Mas'd I-IV.
T.	Without Visualization.	——	——	10.67
	With Visualization.	6.93	5.08	——
	Eyes Open.	6.25	5.06	——
R.	With Visualization.	8.81	6.93	8.91
	Eyes Open.	6.55	4.08	——
We.	Normal.	8.57	6.02	——
	With Visualization.	9.27	6.47	——
K.	Normal.	6.86	3.47	7.55
Wn.	Without Visualization.	6.09	4.41	——
	Eyes Open.	4.14	3.63	
	With Visualization.	——	——	5.94

4. Another interesting feature of the investigation was the constancy of the tendencies controlling the *direction of the error*. There are, evidently, several factors at work in the determination, within the limen, of the direction which the error will take. Some of these the investigation afforded a means of analyzing out. The most noticeable tendency was a displacement towards the wrist. The number of errors in

this direction is greater on the outside of the arm than on the inside, greater on the left arm, where the localization was made with the right hand, than on the right arm. The results from two reagents, tabulated to show this tendency, are given in Table IV. Here again we give the results from the reagents from whom we have the greatest number of observations. The results from the three methods, with visualization, without visualization, and with eyes open, are massed for convenience. All separately show the same tendencies. In collecting the results, the errors in the oblique directions were halved and one-half added to each of the principal directions between which the error was situated. In the abbreviations at the top of the columns, the first letter designates the hand, left or right, on which the experiment was made; the second indicates the part (left, centre, right) of the arm stimulated. The per cents. at the bottom of the columns show the ratio of peripheral errors to all errors made in the vertical line.

TABLE IV. Unit = 1 mm.

Reagent Wn. 58 series; 1,392 experiments.

L. L.	L. C.	L. R.	R. L.	R. C.	R. R.
$P. = 127\frac{1}{2}$	$P. = 93\frac{1}{2}$	$P. = 67\frac{1}{2}$	$P. = 35$	$P. = 65\frac{1}{2}$	$P. = 87\frac{1}{2}$
$C. = 36$	$C. = 38\frac{1}{2}$	$C. = 65$	$C. = 87$	$C. = 63$	$C. = 66$
78%	71%	51%	28%	51%	57%

Reagent T. 20 series; 480 experiments.

L. L.	L. C.	L. R.	R. L.	R. C.	R. R.
$P. = 39\frac{1}{2}$	$P. = 48$	$P. = 26\frac{1}{2}$	$P. = 23\frac{1}{2}$	$P. = 22\frac{1}{2}$	$P. = 21\frac{1}{2}$
$C. = 22$	$C. = 14\frac{1}{2}$	$C. = 21$	$C. = 28$	$C. = 20$	$C. = 29$
64%	76%	56%	46%	53%	41%

One important factor in causing this displacement towards the wrist is probably the overestimation of movements due to flexion and underestimation of those due to extension, when the arm is much flexed. As the reagent ordinarily sits at

the table with one arm resting on it, the other arm is naturally flexed nearly to its limit in making the localization. This view is strongly supported by the experiments of Loeb.[1] In exhaustive experiments made on the estimation of distance by movements of the hand, Loeb finds that there is always an overestimation where the muscles that give the initial movement are already contracted, and an underestimation where they are extended; *i. e.*, movements in flexion, where the limb is much flexed, are overestimated, and underestimated where the limb is much extended; for movements in extension the reverse is true. In translation from visual space (in terms of eye movements) into motor space (with hand movement), there is the same underestimation of movements of extension, increased by overestimation of the space moved through by the eye. In both cases the problem seems to be the same as our own—to determine the errors which arise when translating from the visual space diagram into muscular movements. In the second case, the results were affected by the divergence of the physiological visual space in the remoter parts of the field of vision from the normal visual space, while in our experiments, the normal visual space (which also probably formed the measure in Loeb's first case) was called up directly by the tactual impressions. We must replace Loeb's explanation of the phenomenon, that the errors in estimation are due to the differences in the extent of movements for the same amount of innervation, by an explanation in terms of a subjective equality between distances in visual space and the amount of sensations from the moving member. It is not that equal innervation sensations correspond to equal lengths of movement, but that equal lengths of movement give greater amounts of motor sensations, and these are taken to mean greater distances in the visual space diagram.

Of remotely related literature there is a little. Münsterberg's[2] pleasure-pain experiments on flexion and extension were evidently performed with the arm more extended, and, hence, would have no weight as compared with this position of the arm. Krohn's[3] method, if fully made use of, would give important evidence as to whether the error is due to the cutaneous sensibility or "muscle sense," but the results are recorded in such a schematic manner and the whole investigation is so uncritical and apparently so inaccurate that but

[1] *Untersuchungen über den Fühlraum der Hand.* Pflüger's Arch., XLI, pp. 107-127. *Untersuch. über d. Orientirung im Fühlraum d. Hand u. im Blickraum.* Ibid., XLVI, pp. 1-46.

[2] Beiträge, 4tes Heft, pp. 216 ff.

[3] *Journal of Nervous and Mental Diseases*, March, 1893.

little can be obtained from it. Cattell and Fullerton[1] established the fact that small distances were overestimated and large underestimated. This probably is one of the more general laws under which these facts of displacement come. At extremes of flexion, further flexion gives more intense sensations (increases strain sensations in sinew and probably sensations of contraction in muscle also) than the same extent of movement in extension. Quantity of sensation is probably in part correlated in consciousness with extent of movement. We should then have a positive error in localization during extension, a negative error during flexion, and the point would be localized as we find it in our experiments, nearer the wrist than the point sought.

Further evidence for this hypothesis is given in our results by the increase of displacement as one proceeds from the inside of the arm (right side of left, left side of right), where the flexion of the arm is least, to the outside, where it is greatest. This factor, however, is to some slight extent crossed by the tendency to stop on the side of the given point from which it is approached. During the experiments on the left arm, the right hand usually rested near the wrist, or at a point more extended than the point given to be localized. During the experiments on the right arm, however, the left hand usually rested nearer the elbow than the point given. Consequently, in certain of the experiments we find this tendency added to the former on the left arm and subtracted from it on the right, where in some cases it completely nullifies the other.

There is also noticed, in general, some tendency away from the boundaries of the arm when the given point is on the side. During the first experiments, the reagent would occasionally miss the entire arm at the first attempt at localization. Probably fear of this error led him to localize further within than he otherwise would have done. The total results for all series show 196½ errors away from the boundary and 143 towards it for *Wn.*, and 68½ away and 58 towards for *T.* The other reagents show the same tendencies in about the same degree.

All the muscular tendencies noticed in this section are of influence only within the limen. They would, on *à priori* grounds, have no validity outside of the limen. Nor do they seem to determine the amount of the error within the limen. There is no relation noticeable between the tendency to localize in a given direction and an increase of the average error in that direction. An examination of the Tables will show

[1] "On the Perception of Small Differences." *E. g.*, pp. 48, 49.

that the error in the direction *P.* is not proportionately larger than the others, in spite of the pronounced tendency to localize in that direction.

5. During the course of the investigation, the results of M. Henri's[1] experiments came to our notice. His reagents localized the impressions upon a photograph of the arm. The same method had already suggested itself to us, and was employed in some series of experiments. We give the results obtained from the reagent *T.* Two series were taken, one with visualization and the other without particular regard to the visual image.

During the experiments the reagent's arm was screened from his view. A point was touched on his arm, and the pressure continued while he localized it upon the photograph in front of him. The points experimented upon were approximately those used in the previous investigation. They were accurately marked and the same points used for each series. In order that the reagent should not be influenced by a knowledge of the schema, the photographs were used in such an order that the plan did not appear on any of them.

We give the results for the two series collected on single photographs. In the results it will be noticed that the error is in general much greater than in the former experiments, and the difference between the upper parts of the arm and the area marked by the folds of the wrist joint is much greater. This increase of the error is due, in all probability, to the lack of the correcting influence of the local signs present in the other method as the skin is touched in the search for the original stimulus. Here the first translation into visual space must suffice; there can be no further aid received from the new contacts. The folds of the skin at the joint, however, are prominent landmarks, to which the point can be accurately referred, and by whose aid it can be correctly localized. The cords are not so prominent in the photograph as on the skin itself, but in any case would only aid in fixing the point on its vertical line. The increased tendency to localize towards the wrist is in part due to an estimation of the distance in terms of the portion of the wrist usually exposed, without consideration of the increased surface offered by the turning back of the sleeve. Besides this, the tendencies noticed as effective in the other problem are at work with increased effect, since the restraining influence of the pure tactual limen of twoness is to a large extent lost.

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[1] *Récherches sur la localisation des sensations. Archives de physiologie*, No. 4, 1893, 619-627.

The increased power of localization, when the subject is visualizing, is very striking. Here the translation into visual terms before attempting to localize is more complete, and the subject is much better prepared to perform the localization with something like visual exactness.

On the whole, however, it seems that the errors avoided by the method are not so great as is the new one introduced. The problem changes its form to a certain extent, and becomes a matter of estimating the distance of a known point from different landmarks and then recording this estimation by a second estimation of distances in a slightly different field.

Postscript.—Since the above was written, Lewy's[1] article on memory has appeared. In this, use is made of the same method to test the memory of localization for both normal and pathological subjects, in the hope of discovering a method of diagnosing mental diseases. The results agree with our own so far as they cover the same ground. There is found the same marked displacement towards the wrist in all subjects. Lewy seems to incline towards an explanation in terms of the local signs, but does not attempt to give a full explanation. There is found the variation in the size of the error with the part of the arm experimented upon. This, however, is successfully avoided by using a very small portion of the arm. Fechner's method of mean error is used in interpreting the results without any compensation made for the error peculiar to this problem: that the average error is always too small. The various factors (visual, motor and tactual) that affect the memory do not seem to be well controlled in the experiments.

Summary.

1. Weber's second method gives a valid measure of the limen after the proper correction has been applied to the average error of localization.

2. Every tactual impression is a compound. This can only be separated into its elements after much practice, and by persons of strong powers of attention and introspection.

3. The change of direction in the long axis of the limen, as one proceeds from upper arm to wrist, is probably due to the visual image connected with the pressure sensation proper.

4. The tendency to make an error towards the wrist is probably due to the overestimation of the extent of muscular movements of flexion as compared with movements of extension.

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[1] *Experimentelle Untersuchungen über das Gedächtniss. Zeitsch. f. Psych. u. Phys. d. Sinnesorg.*, VIII, pp. 231 ff.

5. Localization on a photograph, while giving some interesting results on other points, does not provide an accurate means of determining the limen of twoness.

X.—On the Affective Tone of Simple Sense-Impressions.

By D. R. Major, B. S.

The aim of this study was largely methodological. We wished to test the validity of the serial method, already employed in æsthetics by Witmer,[1] and given by Külpe as one of the two principal methods of affective investigation.[2]

Our experiments were carried out in the months January to June, 1894. Just as we had prepared our material for publication, we received Vol. X., Pt. 4, of the *Philosophische Studien*, in which is contained J. Cohn's paper: *Experimentelle Untersuchungen über die Gefühlsbetonung der Farben, Helligkeiten, und ihrer Combinationen.* It seemed better to defer publication till we had compared the two sets of results. In what follows, therefore, constant reference will be made to Cohn's article.

Methodological.—Külpe writes of the serial method as follows: "Sie geht von der Thatsache aus, dass, wenn auch absolut die Gefühlswirkung eines Reizes unter verschiedenen Umständen sehr verschieden ausfällt, immerhin die einzelnen Reize das Gefühl in constanter Form *relativ* bestimmen oder beeinflussen können. Wenn ich z. B. in der Stimmung bin alle Farben gleichgiltig zu finden, so werde ich dennoch unter einer Anzahl mir vorgelegter Farbentöne Unterschiede ihrer Wirkung auf mein Gefühlsleben anzugeben im Stande sein . . . . . Der Vorzug oder die Zurücksetzung, die den Werthen innerhalb einer solchen Reihe zu Theil werden, geben uns dann einen Aufschluss über die Abhängigkeit des Gefühls von den Reizen . . . . . Eine strengere Ausbildung der Methode hat noch nicht stattgefunden . . . . . Bei [ihr] ist offenbar die Abhängigkeit der Gefühle von den Reizen im allgemeinen nur durch eine Curve darstellbar, deren Verlauf die subjectiven Aenderungen zur Anschauung bringt, die einer bestimmten Aenderungsform der Reize entsprechen. Die einzelnen Werthe dieser Curve haben keine absolute Bedeutung, sondern sind lediglich abgestuft zu denken vom relativ Unangenehmsten bis zum relativ Angenehmsten . . . . Wir können uns die Gefühlsänderung selbst als einen rein

[1] *Phil. Stud.*, IX., pp. 209 ff.
[2] *Grundriss*, p. 239.

quantitativen Process vorstellen, in dem das relativ Unangenehmste ein Minimum, das relativ Angenehmste ein Maximum bildet. Alle Zwischenstufen zwischen diesen Grenzwerthen würden eine stetige Verbindung zwischen ihnen herstellen . . . . . ."[1]

Cohn (1) recommends the "gründliche Heranziehung einzelner Personen" (p. 564). Our experience coincides with his. We confined ourselves to the examination of three subjects: Miss Carss *(C.)*, Miss Hunt *(H.)*, and Mr. Lighty *(L.)*. (2) He declares the serial method inapplicable to colors, for two reasons. In the first place, the qualities contrast with one another, so that a different impression follows from each particular presentation of a series. Secondly, the separate colors "operate not as members of a continuous series, but as independent qualities." Both objections are true: but it is a question whether one should give the method up altogether on their account. We endeavored to meet them, as follows.

I.

To take visual impressions first:—there is the initial difficulty of a color and brightness standard. Cohn, in face of this difficulty, constructed a color circle.[2] "Man sieht . . . wie roh und unexact dieser Farbenkreis ist. Im Folgenden wird sich zeigen, wie gute Dienste er trotz alledem leisten kann." We made no attempt at a new standard, but simply cast about for a convenient series of colored and bright surfaces. Such a series we found in the Bradley Educational Colored Papers (dead finish).[3] The "spectrum scales" of the M. Bradley Co. contain ninety-five saturations; nineteen fully saturated or typical colors, and, for each of these, two less saturated qualities, obtained by the intermixture of different degrees of black, and two obtained by the intermixture of white. The company kindly sent us a number of unclassified additional papers, which we arranged like the rest, as carefully and accurately as possible. We thus obtained a total of 137 color qualities. Besides these, we had twelve qualities from those of the brighness scale.

The first objection to the serial method is the influence of contrast. This renders it impossible to present a series of colors simultaneously. To avoid it, we exhibited but one visual quality at a time. Squares of 6 cm. were cut from the

[1] *Op. cit.*, pp. 239-242, 254, 257, 260. For the method as employed by Witmer, cf. *Phil. Stud.*, X., p. 563.

[2] Pp. 566-569.

[3] See *The Bradley Color Scheme*, p. 6; *Bradley's School Aids*, pp. 1, 2.

stimulus papers. These were exposed, in two different experimental series, upon cardboard backgrounds of white and black respectively. The cardboard in each case was 60 cm. square. Behind it, at the distance of about 1 m., was a wall of neutral yellow-grey. The observer sat, with closed eyes, 2 m. from the card upon which the stimulus paper was exposed. The signal for attention was given 2″ before exposure; the exposure was made for 2″; and some 10″ were allowed for the recording of the affective judgment. Often less time was needed for this last.

This method of isolated exposure constitutes, of course, a radical modification of the serial method. Does it involve the serial method at all? And does it get rid, as it was intended to do, of contrast effects?

The answer to the first of these questions leads us to the second objection: that the colors operate as independent qualities. In our experiments they certainly did not. Our plan was: to begin the experimental series at any point in the spectrum; to move always, having begun, from right to left along the spectral series; to set out either from the whitest or from the blackest saturation of the color chosen as the first stimulus, and to present all the saturation degrees of this color before passing to the next,—then to take the saturation degrees of this next color in the same order,—and so on; and to give the whole series of 137 stimuli at each sitting. Thus the observers, who were familiar with the solar spectrum, knew the spectral direction of the series, and could hold the total scheme more or less definitely in memory; while at the same time the number of saturation degrees of each color afforded a sufficient break between color and color. The beginning of the total series at any point of the spectrum was a further correction of possible *Einstellung*. Again, not only were the impressions held together serially by aid of the memorial spectral scheme, but each separate group of saturation degrees of a single color formed a minor series in itself, from term to term of which the affective judgment might vary considerably. As stated above, the order of exposure of saturations might be either from dark to light or from light to dark; but it was constant within the same series, and therefore known to and expected by the observer after the first few impressions had been given.

On this method, contrast, if present at all, would plainly tend to be not contrast of color with color, but contrast of *e. g.*, the brightest saturation of one color with the darkest saturation of the next following. But of any such contrast effect there is no trace in the experimental results. Partly, it may be, the time interval between experiment and experi-

ment was long enough, and the time of exposure short enough, to prevent it; partly, the observers were on their guard against allowing expectation to pass over into comparison; partly, it seemed that, at the conclusion of each minor series of saturation degrees, this series was replaced in mind by the thought of the total spectral series—the expectant attention turned to the next color in general, and not to a particular saturation degree of it, so that, again, a direct mental comparison was avoided.

Of course, with either background, there was induction. And the error so introduced, though purporting to be constant, was not so in reality, since the brightness of the six "principal" colors in the Bradley scheme (as in the spectrum) are by no means the same. But it seemed unavoidable. Some trial experiments were made in the winter of 1893 with large colored surfaces. In every case the observer expressed himself as feeling "discomfort" in the presence of the extended stimulus, and was convinced that judgment would be more prompt and certain if the stimulus surface was reduced in size. Moreover, the extended color exhausts the retina, leaving the after-effects of exhaustion behind it. It is noteworthy that incidental remarks to this effect were dropped by the observers *C.* and *H.* during the present experiments.

(3) Cohn attributes to the serial method a "fundamental error." It is inadequate. "Sie kann nur einen oder den andern Hauptpunkt der Curve, nicht die Curve selbst feststellen." This is true of the method in its usual form. To obviate the difficulty, we formed an arbitrary scale of affective values. It was found, after a good deal of testing, that seven such values could be readily held in memory. They were: 1, very pleasant; 2, moderately pleasant; 3, just pleasant; 4, without affective tone; 5, just unpleasant; 6, moderately unpleasant; 7, very unpleasant. This scale was written upon a blackboard in the experimenting room; so that the observers could refer to it before experimentation began, and refresh their memory by casting a glance at it between experiment and experiment, before closing the eyes. If we take 4 as the abscissa of the affective curve, it is clear that 1, 2 and 3 may be regarded as positive; 5, 6 and 7 as negative ordinates.[1] We do not mean, of course, that there is anything absolute in the curve thus obtained. It was very quickly noticed, during our experiments with visual impressions, that the observers were not accustomed to attribute the terms "pleasant" and

[1] This procedure is not that criticised by Külpe, p. 241.

"unpleasant" to visual stimuli of the kind investigated. Hence, when it was required of them to predicate these terms, they attached individual meanings to them. *L.* persisted throughout in regarding as visually unpleasant only a stimulus which was absolutely injurious, destructive to the organ, such as direct sun-light. His curves, therefore, show hardly any negative ordinates. Often he described a color as "ugly"; but did not on that account find it "unpleasant." For *C.* and *H.*, on the contrary, "ugly" and "unpleasant" meant, so far as we could tell, the same thing. The curves of *L.* and of *C.* and *H.* cannot on this account be compared with one another. Nor do we claim anything but relativity of result within the limits of the same curve. That 1 is so high above 4, absolutely, as 7 is below it, we have no means of knowing. What we do maintain, however, is that in these seven affective values, we have a sliding scale which is easily memorized, which assists the observer in the formation of an affective judgment, which is applicable to the series of impressions whatever the mood *(Stimmung)* of the observer at the time of experimentation may be, and which removes in a relatively trustworthy way the "fundamental" objection of the inadequacy of the serial method. The results shall speak for themselves later. It should be mentioned that to eliminate the direct memory error, we worked only once a week.

The Affective Judgment.—Our notes on this head practically coincide with those of Cohn (pp. 596 ff.). We noticed the difficulty of obtaining the "gleichmässige Gemüthslage" from the observers. This is partly due to the causes enumerated by Cohn (the confusion of the æsthetic with the affective judgment, the conviction of the "subjectivity" and uncertainty of the experiment, etc.); partly to a cause which we have mentioned above, the unaccustomedness of the required judgment. We found, again, the tendency to theorize; to put reflection in the place of direct experiencing. We were not able, however, like Cohn, to treat our observers' suggestions with "cool scepticism," at the time of their utterance. This would have meant a discontented mood and variable judgment on their part. We treated the suggestions with some respect; but discouraged their making during an experimental series. In other words, instead of discouraging introspection altogether, as Cohn did, we worked towards mechanization during the experimental hour, but allowed the observer to introspect memorially at its conclusion. Many of the suggestions could be discounted at once; but the observer — ignorant of the actual aim of the investigation — was flattered and put into a good mood by being able to discuss

them, and see them noted down. The point is a difficult one; and every observer must be to some extent individually handled with regard to it.

We noticed, like Cohn, that the number of distracting associations decreased as the experiments progressed. This we ascribe partly to the serial nature of the impressions (Witmer), partly to the number of experiments made (Cohn). There were, altogether, but few associations. The observer *L.* remarked that it was generally possible to judge of the color as color; but that if once a train of association was allowed to start, it was liable to persist. This latter statement was confirmed by the other two observers. Greens seemed for all three observers to be the richest in associations. It was hard to discover the reason: *C.* suggested the green of vegetation, *L.* silk dresses. There were three main types of association: (*a*) with natural objects—flowers, birds, etc.; (*b*) with moods (Cohn, p. 590); (*c*) with objects of analogous attributes, delicate tones being associated to fragile fabrics, etc. (Cohn, pp. 565, 598.)

As regards the effects of mood, the utterances of our observers differ somewhat from those of Cohn. He found that a particular mood might condition a particular judgment; and that a good mood meant a better cognition of affective differences. We obtained no instance under the first rubric: that may be simple accident. As regards the second point, we noticed that "good spirits," a pleasant day after much wet weather, etc., so far from emphasizing the differences between the pleasant and unpleasant impressions, sent all impressions alike up in the direction of pleasantness. Mood appears to be a factor which varies with different individuals.

Two of Cohn's observers remarked on occasion that the order of experimentation influenced judgment. One of our own *(H.)* made a similar remark two or three times. But the remark was made as an "impression" at the conclusion of the experimental series; and no trace of any such influence could be found in the observer's results. Such unreliable "impressions" are especially apt to arise in unfavorable moods. In certain cases the direct result of stimulation of the sense-organ determined the affective judgment. "Cool," "restful" colors were pleasant; dazzling, blinding, "angry" colors unpleasant. The cases are not numerous.

Results of Experiments with Visual Impressions.—We proceed to give in Table I the results of experiments upon our 137 saturations. The spectrum is divided into twenty-seven qualities, described as: between violet-red and red-violet; violet-red; red; orange-red; red-orange; orange; yellow-orange;

orange-yellow ; yellow ; green-yellow ; between green-yellow and yellow-green ; yellow-green ; green ; green-blue-green ; blue-green ; between blue-green and green blue ; green-blue ; extra green-blue ; slate blue ; blue ; violet-blue ; blue-violet ; slate violet ; violet ; extra red-violet ; extra violet-red ; red-violet. The nomenclature is, as has been indicated, to a certain extent arbitrary. For each of these qualities there is a principal quality or most saturated color ; (this is placed in the curve upon the vertical line indicated above by its initial letter or letters, and below by asterisks ;) and a number of less saturated qualities, dark and light. The order in the curve is in each case from light to dark. The total number of saturations, besides the normal color in each minor series, is : (1) 2 light and 3 dark ; (2) 2 and 3 ; (3), (4) 2 and 2 ; (5) 3 and 2 ; (6) 4 and 2 ; (7) 3 and 3 ; (8) 2 and 3 ; (9), (10) 2 and 2 ; (11) 2 dark only ; (12) 2 and 2 ; (13) 2 and 3 ; (14) 1 and 3 ; (15) 2 and 2 ; (16) 1 and 1 ; (17), (18) 2 and 2 ; (19) 1 and 1 ; (20), (21), (22) 2 and 2 ; (23) 2 dark only ; (24), (25) 2 and 2 ; (26) 2 and 3 ; (27) 2 and 2,—in all, as stated, 137. It may be noted that while the normal series for each color contained five qualities, there was sufficient irregularity to prevent any exact definitizing of the attention :—another reason for the absence of contrast effects in the results.

The figures in vertical lines to the left of the curves represent the affective judgments ; 1 = very pleasant, 7 = very unpleasant.

The first letter above each curve gives the name of the observer. The seventh curve (*W.*) was taken from a subject not hitherto named, Miss L. Washburn, who was only present during the first part of the investigation.

The second letter gives the background ; *W.* = white, *B.* = black.

The figure following shows the number of times that affective judgments were recorded by the observer for the whole series of 137 saturations, apart from practice experiments.

All experiments were made in diffuse daylight, under constant conditions of illumination.

Several questions arise in connection with this table.

(*a*) Was the affective judgment constant ? And if so, within what limits ? It would appear to be a defect of the serial method in the form in which we have employed it, that but few judgments of the same stimulus can be taken. Thus although *C.*, *e. g.*, was the subject of 1,233 experiments with the black background, each particular saturation was affectively estimated only nine times. It might be expected that this would mean a very large *m. v.* But the results give the con-

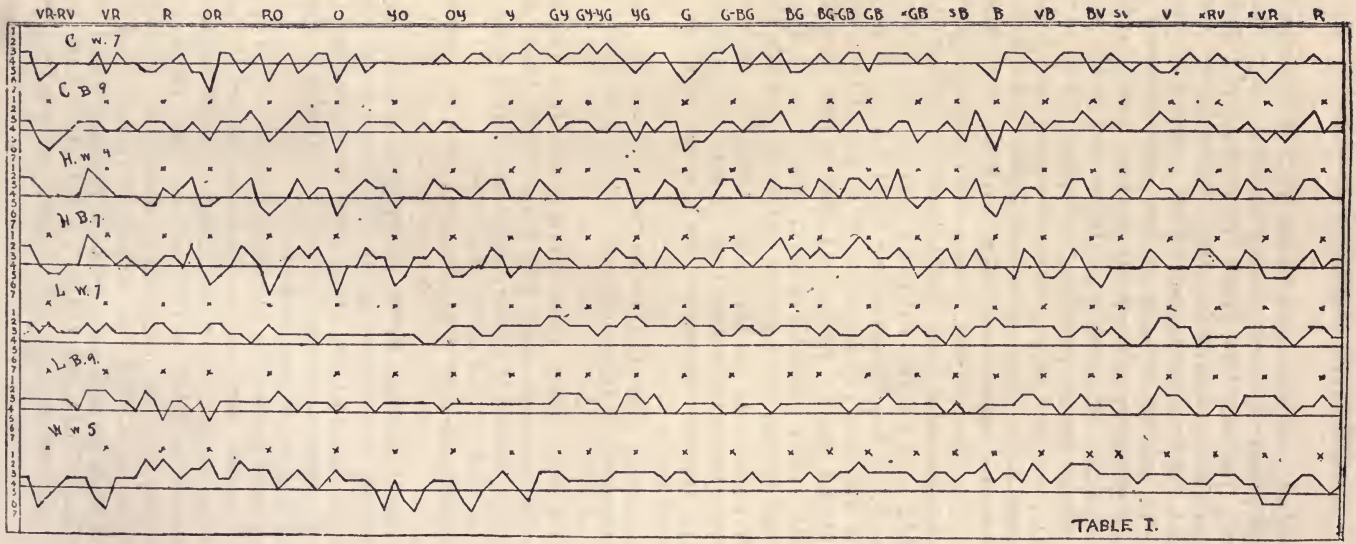

VR-RV VR R OR RO O YO OY Y GY GY-YG YG G G-BG BG BG-GB GB -GB sB B VB BV sV V -RV -VR R
C w. 7
C B 9
H. w 9
H B.7
L w.7
L B.9.
W w 5

TABLE I.

trary verdict. On the average, for each individual, there was a quite unexpected constancy of judgment.

It would be easy to prove this constancy by giving the *m. v.* for each of the 137 saturations and for each observer. But, apart from the cumbrousness of such a method, the table constructed would be to some extent misleading. First, the judgment-series present several well-marked types,—which could not be differentiated; while, secondly, the same *m. v.* would have a very different psychological value, according as it was a variation within one and the same affective quality, or between the two, of pleasantness and unpleasantness. We will, therefore, rather enumerate the types of judgment-series obtained, together with actual illustrations of them, these illustrations serving to indicate the range of the *m. v.*

i. *Perfectly regular affective series.* *L.*; 1, 1, 1, 1, 1, 1, 1, 1, 1. *H.*; 3, 3, 3, 3; 5, 5, 5, 5, 5, 5, 5. *C.*; 3, 3, 3, 3, 3, 3, 3, 3, 3. *W.*; 2, 2, 2, 2, 2. These series were naturally rare; although considerably more occurred than we had looked for.

ii. *Affective series becoming regular as experimentation progressed.* *C.*; 5, 5, 3, 3, 3, 3, 3. *L.*; 4, 3, 3, 3, 3, 3, 3. These were more numerous.

iii. *Series varying within the same affective quality.* *C.*; 5, 5, 6, 6, 7, 6, 6: or 5, 6, 6, 6, 5, 6, 6, 5, 5. *L.*; 2, 2, 2, 1, 1, 3, 3, 3, 2. *H.*; 7, 5, 7, 6. *W.*; 5, 7, 5, 5, 6. These were very numerous indeed.

[Cross-series between ii. and iii. were common. Thus: *C.*; 2, 5, 5, 6, 5, 5, 5. *H.*; 3, 2, 2, 2, 2, 1, 2.]

iv. *Regular series abruptly broken by a single term.* *C.*; 5, 5, 5, 5, 3, 5, 5; 3, 3, 3, 4, 3, 3. *H.*; 3, 3, 2, 3; 4, 4, 2, 4.

[The pure type is not very common. Quite frequent, on the other hand, are cross-series, involving iv. and iii., iv. and ii., or all three types. Thus: *C.*; 4, 5, 5, 5, 3, 5, 5=ii. and iv.; *C.*; 1, 2, 3, 3, 4, 3, 3, 3, 3=ii. and iv.; *C.*; 5, 3, 6, 5, 6, 5, 5=iii. and iv.; so *H.*; 5, 5, 3, 6, 5, 5, 5; and *L.*; 5, 5, 6, 5, 5, 3, 5; or 3, 7, 2, 2, 2, 3, 3; *L.*; 2, 3, 3, 3, 3, 5, 3, 3, 3=all three; etc.]

v. *Progressive and regressive affective series.* These are very rare; and cannot, we think, be referred to any but variable influences. We have only the following out of the total number of series: *L.*; 2, 3, 3, 3, 3, 3, 5, 5, 5: *H.*; 1, 3, 3, 3, 3, 5, 5 (this may really be a combination of ii. and vi.): *C.*; 5, 5, 5, 5, 6, 5, 6, 7, 7 (this is a cross-series of iii. and v.): *H.*; 5, 7, 5, 5, 2, 2, 2 and 5, 7, 7, 5, 3, 3, 3 (iii. and v.); *cf.* *L.*; 6, 4, 3, 1, 2, 2, 2. These six or five cases, taken together with a very few doubtful

ones, seem to require the rubric. We can understand that familiarity should make an impression pleasanter; but it is difficult to understand why one should become less pleasant,—unless acquaintance with so large a color series gave the subject a richer mental furniture, and made him or her more critical as experimentation progressed. In neither case do we imagine recognition to have taken place.

vi. *Series of indifference.* By our figure 4 we do not, of course, understand a new affective quality, beyond those of pleasantness and unpleasantness; the judgment "no affective tone" corresponds to it. We can here distinguish sub-types:

(*a*) *Regular non-affective series.* *H.*; 4, 4, 4, 4, 4, 4, 4; so *C.*—*L.* has 4, 4, 4, 4, 4, 1, 4 (complication of vi. *a* with iv.). The type is fairly common with *H.*; else rare.

(*b*) *Vacillations round the non-affective judgment.* *C.*; 5, 5, 3, 5, 3, 3, 3; a series whose type frequently recurs in *C.*'s results. *H.*, 3, 3, 5, 5, 5, 3, 3; etc. Besides these, we have series in which the 4-judgment itself occurs. *H.*; 4, 5, 5, 4, 3, 3, 3; or 3, 3, 4, 4, 4, 4, 4 (*cf.* ii.). *C.*; 4, 3, 4, 3, 4, 4, 5, 5, 4. *L.*; 3, 4, 4, 4, 3, 5, 4, 5, 4. [Cross-series were again frequent.] With these, *cf.* the *Gleichheitsurtheile* mentioned by Cohn, p. 598.

vii. *Irregular series.* These are very rare; most seemingly irregular series reducing themselves to order on a close inspection. We find: *C.*; 3, 2, 6, 5, 3, 3, 4; 5, 3, 3, 6, 7, 5, 5; *L.*; 2, 3, 1, 4, 5, 3, 5; *H.*; 3, 7, 6, 3, 6, 3, 3;—but these are the only instances of really irregular series; and even of them, the second and third are perhaps regressive. Such series as: *L.*; 6, 4, 3, 1, 2, 2, 2 show (as remarked above) a distinct affective tendency. Again, we have from *C.* the series: 2, 2, 6, 7, 6, 3, 3,—but notes on the observer's record-cards explained the three high figures as due to a particular influence.

These statements must not be misunderstood. The results are by no means artificially regular. Types i. and vi. *a* are rare, as stated. Nearly every series shows irregularity of some sort. But the variation is either by way of an isolated interruption (type iv.), due to mood, etc., or lies within one and the same affective quality (type iii.; extremes 1 and 3, or 5 and 7). In no other instance than those mentioned is there a variation from 7 to 3, 6 to 2, or 5 to 1, which is not referable to one of the above rubrics. We ascribe this regularity partly to the unaccustomed nature of the required judgments,

—the observers tended to move cautiously within the limits prescribed for them, so that the values 5 to 2, inclusive, predominate in the records; partly to the mechanization of the judgment,—a point emphasized by Cohn; and partly to the taking up of a definite affective attitude toward particular saturation types. Of this last, more presently.

Plainly, the giving of the *m. v.* of these results would be useless, and even misleading. The results require careful individual evaluation.

(*b*) Is a greater or less degree of saturation on the average more pleasant? Cohn writes: "Von zwei Nüancen derselben Farbe gefällt die gesättigtere besser. Auch unter einer Reihe verschiedener Farber werden im algemeinen die gesättigteren bevorzugt" (p. 511). A glance at the first four curves of our Table I. will show that for the observers *C.* and *H.*, precisely the opposite holds. There is generally an "absolute" unpleasantness attaching to the more saturated colors; nearly always a relative unpleasantness. The curves are exceedingly regular in this respect. For *L.* it is different. The most saturated colors usually coincide with high ordinates throughout his first curve; and with fairly high ones in the second part of the second. In the first half of the latter, however, some of the most saturated colors coincide with minima of pleasantness. *W.*'s curve varies in this respect. At the beginning and end, the curve drops for saturated impressions; but over the greater part of its course it rises to them, or remains stationary when they occur.

Cohn's rule, then, is not universal (p. 600). There are great individual differences. When one thinks how dependent the sense-feeling is upon central excitations, that is not to be wondered at.—Of course, Cohn used a different method from ours, and employed principally gelatine plates and rotating discs where we had colored papers. Still, this cannot of itself account for the discrepancy.

Cohn continues: "Unter annähernd gleichgesättigten Farben scheint die Bevorzugung auf rein individuellen Neigungen zu beruhen. Nur das Gelbe dürfte für die Mehrzahl hinter den anderen Farben zurückstehen, auch wenn es ganz gesättigt ist." Taking our own most saturated colors, *R*, *O*, *Y*, *G*, *B*, *V*,—although we do not mean to imply that their saturations are absolutely equal,—we find that:

(i.) *C.* makes *O*, *G* and *B* distinctly unpleasant; *R*, *Y* and *V* just pleasant, just unpleasant, or indifferent.

(ii.) *H.* makes *O* distinctly unpleasant; *B* rather so; *R* just pleasant; *G*, *Y* just unpleasant or indifferent; *V* just pleasant or indifferent.

(iii.) *L.* makes the right hand of the spectrum more pleasant than the left. *R* alone falls below the abscissa of "no affective tone."

(iv.) *W.* makes *R* the most, *B* and *Y* the least pleasant colors. All are pleasant.

Here we have full evidence of the "individuelle Neigungen;" but none of a dislike of yellow. Yellow is just pleasant for *C.*; just unpleasant or not toned for *H.*; moderately or just pleasant for *L.*; just pleasant for *W.* Cohn's caution as to the insufficiency of his own results is, therefore, well in place.

(*c*) We may examine this same question, of the relative pleasantness of saturation degrees, in connection with the further question of the influence of the background. If we take the twenty-seven best saturations of our color series, and count the no-tone judgments half to pleasantness and half to unpleasantness, we find that:

C.	on	white	makes	8.5	pleasants,	18.5	unpleasants.
"	"	black	"	13.5	"	13.5	"
H.	"	white	"	15.5	"	11.5	"
"	"	black	"	12.5	"	14.5	"
L.	"	white	"	27.0	"	0.0	"
"	"	black	"	23.5	"	3.5	"
W.	"	white	"	23.5	"	3.5	"

Even this table, which throws together saturation-values of very considerable difference, indicates, when its values are compared with the total numbers of "pleasant" and "unpleasant" judgments (their totals being similarly obtained, by halving the no-tone judgments), that Cohn's rule of the superior pleasantness of the saturated color is not universal. We find that, in all:

C.	on	white	makes	77.5	pleasants,	59.5	unpleasants.
"	"	black	"	98.0	"	39.0	"
H.	"	white	"	91.5	"	45.5	"
"	"	black	"	94.0	"	43.0	"
L.	"	white	"	132.5	"	4.5	"
"	"	black	"	123.0	"	14.0	"
W.	"	white	"	120.5	"	16.5	"

In other words:

C.	on	white	makes,	of all,	58%	pleasant;	of	the	27,	31%
"	"	black	"	"	71%	"	"	"	"	50%
H.	"	white	"	"	66%	"	"	"	"	57%
"	"	black	"	"	68%	"	"	"	"	46%
L.	"	white	"	"	96%	"	"	"	"	100%
"	"	black	"	"	90%	"	"	"	"	87%
W.	"	white	"	"	88%	"	"	"	"	87%

So much, then, for Cohn's generalization. We turn now to the second question: that of the influence of the background.

If the members of each of the three first pairs of curves are compared with one another, it will be seen that the type of each pair is constant; 1 and 2 are alike, 3 and 4, 5 and 6. This fact, we may remark incidentally, tells distinctly in favor of the method employed.

Comparing the curves of each pair in detail, we obtain the following results: (i.) In neither curve does *C.* pass the affective value 2; in one case only does she sink to the value 7 (white, *O R*). White has, as we have seen, 13% less pleasant judgments than black. Black, too, has 19% more of the best saturations pleasant than white. White has, in all, 35 no-tone judgments; black 38. On the average, then, the saturations were a little pleasanter on black than on white. In particular: from the beginning to *R*, black is pleasanter; from *R* to *O*, black; from *O* to *Y*, black; from *Y* to *G*, white; from *G* to *B*, both are practically equal,—black having the advantage in the height of the pleasure ordinates; from *B* to *V*, black is pleasanter; from *V* to the end, black. (ii.) *H.* reaches the value 1 twice, on white; three times on black, she sinks to 7 twice, on black. Black has 2% more of pleasants than white. The best saturations have 11% less pleasants, however, on black. White has, in all, 57 no-tone judgments; black 33. Neither background, it is plain, can be said to be more or less pleasant than the other for this observer. Black, however, called out more affective judgments, and shows more extremes, both of pleasantness and unpleasantness, than white. In detail: from the beginning to *R*, white is slightly pleasanter; from *R* to *O* there is practical equality; from *O* to *Y*, again; from *Y* to G, black is pleasanter; from *G* to *B*, black; from *B* to *V*, white (the effect of black is to "impair" these colors, the observer stated); from *V* to the end, there is equality. (iii.) *L.* gives the value 1 eight times on white, once only on black. No impression is unpleasant on white; two are, on black. White has 6% more pleasants than black; the best saturations on white, 13%. White has in all 9 no-tone judgments; black 26. The white background, then, is obviously the pleasanter. The observer himself recorded this fact only in regard to the blues. White is pleasanter for every section of the curve; particularly, however, between *O Y* and *B V*. (iv.) It is unfortunate that we have no black curve to compare with the last one of the table. This curve is particularly well marked: there is distinct dislike, *e. g.*, of the oranges and purples on a white ground. Such a regional dislike is not manifested by the other

observers. *L.* hints at it, for the reds on black. In the other curves, pleasants and unpleasants alternate in more individual preference.—*Cf.* §4 of Cohn's *Results*, p. 600.

(*d*) Are dark or light saturations the pleasanter? If we take the "shades" (dark saturations) and "tints" (light saturations) of the twenty-five qualities (omitting the slate-blue and the slate-violet), we find that, on white:

C.	makes	7	shades	and	5	tints	pleasanter:	13	no-preferences.
H.	"	2	"	"	23	"	"	no	"	"
L.	"	5	"	"	7	"	"	13	"	"
W.	"	6	"	"	14	"	"	5	"	"

Here are two types, evidently: *C.* and *L.* have no preference, while *H.* and *W.* distinctly prefer the brighter saturations. Further, on black:

C.	makes	1	shade	and	21	tints	pleasanter:	3	no-preferences.
H.	"	1	"	"	24	"	"	no	"	"
L.	"	7	"	"	5	"	"	13	"	"

Here are the same two types. *C.* has gone over to the other side; she and *H.* find the brighter saturations distinctly pleasanter. *L.* continues to show no preference. *C.* noted this change of her affective judgment more than once on her record card.

There is no hint of a preference for the darker saturations in the results of any of the observers.

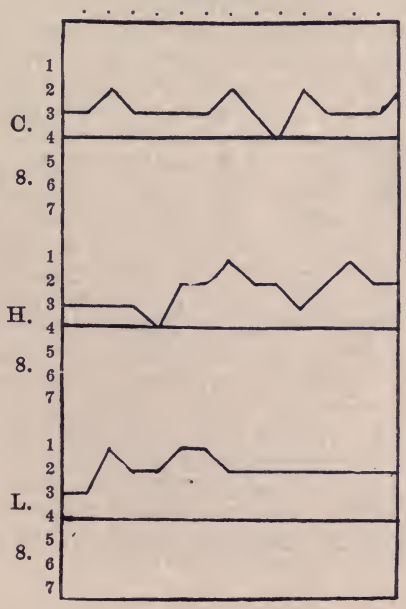
(*e*) Experiments upon the affective tones of the qualities of the brightness-scale were made upon both backgrounds. No brightness-impression is, probably, entirely colorless. Adopting the Bradley nomenclature, we had: a slightly greenish grey, three saturations of "grey," two of "cool-grey," two of "neutral grey," and two of "warm grey," besides white and black. Judgments were taken from *C.* 8, from *H.* 7, and from *L.* 8 times. (*a*) Of the eleven judgments on black, *C.* has 8 marked "no-tone," 3 "pleasant" (values 2, 3, 3); *H.* has 2 marked "no-tone," 8 "pleasant" (seven 3's and one 2), and 1 "unpleasant" (5); while *L.* has 2 marked "no-tone," 7 "pleasant" (3), and 1 "unpleasant" (5). The two unpleasants are white and green-grey. On the whole, then, the qualities on black are just pleasant or indifferent. The individual differences are curious. White gets 3 from *C.* and *L.*, but 5 from *H.* The latter figure tells against Cohn's law of contrast (p. 600). Green-grey gets 2 from *H.* and *C.*, while *L.* gives it 5. This grey, then, is pleasanter than white to *C.* and *H.*, on the black background; while *L.* finds 8 qualities pleasanter than it, of which

white is one. The other judgments, 3's and 4's, are irregularly distributed. There is no trace of the preference of white over grey, found by Cohn, except a very equivocal one in *C.*'s figures. (*b*) The judgments on the white ground are all 3's and 4's, irregularly distributed; except that both *C.* and *L.* give a 5 to the green-grey. *W.* took part in this series, with seven sets of judgments. Black is not pleasanter on the white than any of the greys, with the exception mentioned.— The qualities on the whole, then, are just pleasant or indifferent.

II.

Experiments with Pure Tones.—We made a number of experiments with König tuning-forks. Preparation and signal were as before. The fork was then struck a sharp blow with a cork hammer, and judgment made at once, as the tone became full and clear. The fork was damped, so soon as the experimenter observed that all the subjects had realized the affective tone of the stimulus. A compound piano clang was given after each experiment, to prevent the influence of tone by preceding tone. The order of stimulation was quite irregular. The vibration-rates of the forks, in simple vibrations, were: 512, 576, 640, 682, 768, 853, 960, 1,024, 1,250, 1,536, 2,048, 2,304, 2,560, 1,792. In the table the judgments are recorded in this order.

TABLE II.



The observers again remarked on the unaccustomedness of the ascription of an affective tone to the stimulus. The table shows individual differences : *L.*, as before, is more lavish of his "pleasant" judgments than are *C.* and *H.* For *C.*, the e^3 falls from 2 to 3, the e^4 from 3 to no-tone, the e^5 stays at 3. The d^3 and d^5 are differently toned, so the g^3 and g^4. The three *c*'s are constant at 3. For *H.*, the *e*'s are at 3, 2, 2 ; the *d*'s at 3 and 1 ; the *g*'s at 2 and 3 ; the *c*'s at 3, 2, 2. For *L.*, the *e*'s are at 2, 2, 2 ; the *d*'s at 1, 2 ; the *g*'s at 1, 2 ; the *c*'s at 3, 2, 2. We lay no stress upon this regularity or irregularity,—the experiments have not a sufficient range,—upon the fact that for *H.* the higher tones seem more pleasant, or upon the fact that no judgment falls below the value 4. The method can hardly be called "serial" ; the serial element has been modified practically to disappearance. We would conclude from the results simply this: (*a*) that the smallness of the *m. v.* (each curve implies eight sets of judgments) shows that the affective judgment, once made, is persistent ; (*b*) that individual differences exist here, as for sight, and that these differences are both general (*cf.* the three curves) and particular (*cf. C.*'s attitude to the *e*'s).

III.

Experiments Upon Active Touch.—These experiments were made upon a series of fifty-one textures. The observer sat with closed eyes. At a signal he laid his open right hand upon a rest. A piece of the fabric under consideration was placed between the thumb and index finger by the experimenter ; and the observer moved it to and fro, "feeling" and "judging" it for 2″. Then at a further signal the experimenter removed the stimulus, and the subject recorded his affective judgment.

The stuffs employed cannot be qualitatively classified unless at very great length. We have thought it best, therefore, simply to name them. Samples can be supplied by the laboratory, if anyone should wish to repeat the work with the same stimuli. The following list follows the order of the judgments recorded in the curves from left to right : it was the constant order of experimentation.

Linen canvas, open and close ; linen toweling, coarse, medium, fine ; gingham, thicker and thinner ; percaline ; India dimity ; butterfly cloth ; cotton sateen ; cotton silk, thinner, thicker, thinner-and-smoother ; gingham, thicker, thinner (both thicker than the two previous kinds) ; wool serge, thin ; Paris cachemère ; princess duck ; challie laine ; wool checks, thin, thicker, thicker ; cotton plush, thick, thicker, thick soft, thin soft ; flannel ; velveteen ; washing

silk; organdie, rougher, smoother; broadcloth, thicker, thinner; unbleached muslin; chambray, thinner, thicker; wool serge, thick; Irish lawn; cotton silesia; sateen, rougher, smoother; table linen, bleached and unbleached; dress goods; gingham, ribbed; faced velvet, thick, thicker, thin, thickest; gingham, thick and smooth.

A serial arrangement of these stuffs in any way analogous to the spectral arrangement of colors, could not be carried out: there were too many variables. But we kept the minor series together (as we did the saturation grades of the same color), except in the single case of the ginghams, which we separated from one another for methodological reasons. [The two wool serges were extremely unlike.] We wished to see whether this separation exerted any bad influence, or whether the serial nature of the method — contrast being presumably less marked than in optics—would not be maintained by the simple fact of all judgments coming from the same modalities. We regarded this as probable, because whereas the eye has in all likelihood 40,000 to 50,000 qualities, we have involved here simply pressure and temperature from the skin, and the few qualities of the deeper lying sensibilities that go to make up the movement perception. This ought, we imagined, to hold the stimuli together as a series. We give the curves on page 74.

(*a*) The observers noted that it was far more "natural" to attribute affective tone (and particularly unpleasantness) to these stimuli than to those of sight and sound. And the curves support this: they are all three very much alike,—there is no such indication of individual differences as we have found in the other two tables.

(*b*) The affective judgment was constant, and showed types similar to those enumerated in the first part of this paper.

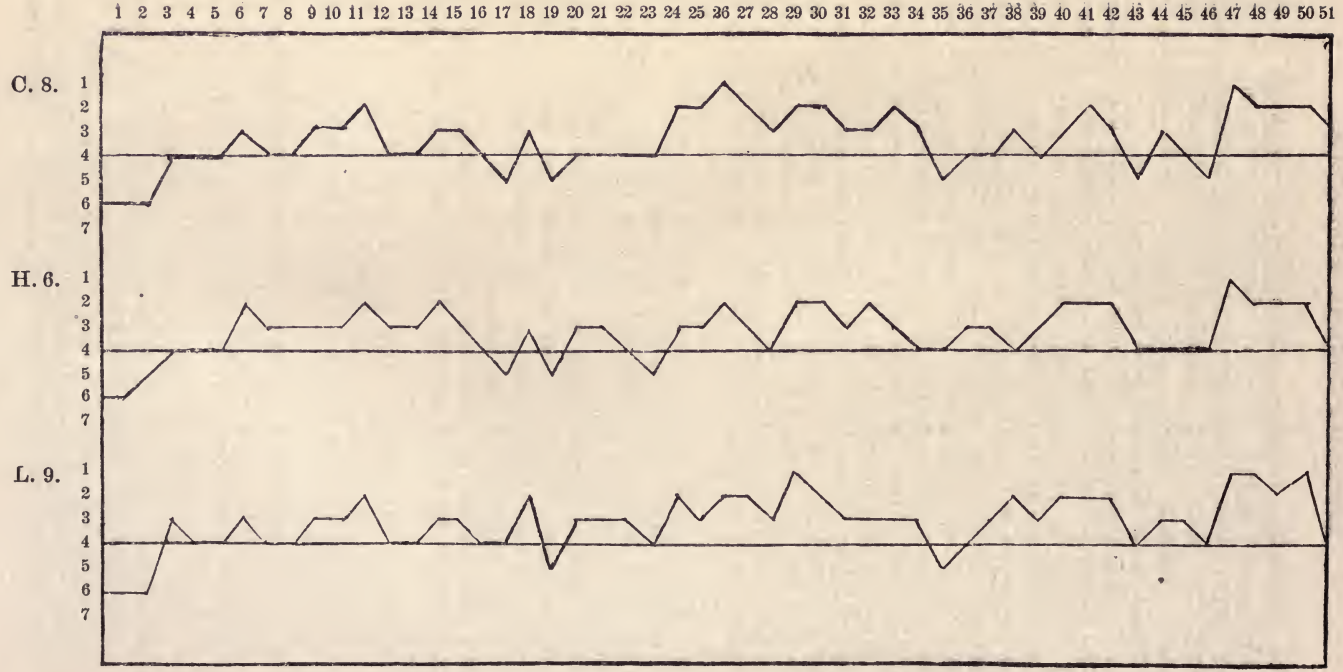
i. Occurs twice only. *C.*; 3, 3, 3, 3, 3, 3, 3, 3; *H.*; 2, 2, 2, 2, 2, 2, 2.

ii. Numerous. *C.*; 1, 2, 1, 1, 1, 1, 1, 1; and 4, 5, 4, 4, 5, 5, 5, 5; etc.

iii. Very numerous. The variation is often between two degrees only. *C.*; 1, 2, 2, 2, 2, 1, 1, 1; *H.*; 3, 2, 3, 3, 2, 3; *L.*; 5, 5, 5, 5, 5, 5, 6, 5, 6; and 3, 2, 3, 2, 2, 2, 1, 2, 2; etc.

iv. Not very common even in the "cross" form. Pure series are: *H.*; 2, 2, 2, 2, 4, 2; and 1, 1, 1, 1, 1, 3; etc. —uncommon. Cross-series are: *C.*; 4, 3, 5, 5, 5, 5, 4, 5 (iv. with ii.); *H.*; 4, 5, 4, 4, 4, 3, 4. We should naturally expect that the interruption would be neither so frequent nor so pronounced in a sense modality in which

Table III.


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51
C. 8.
H. 6.
L. 9.
1
2
3
4
5
6
7

the dependence of affective tone upon stimulus is comparatively stable.

v. No commoner than for the colors, as we should, again, for the above reason expect. *C.*; 4, 5, 5, 5, 7, 7, 7, 7; and perhaps the already quoted 1, 2, 2, 2, 2, 1, 1, 1. These seem to be the only instances.

vi. There is no single occurrence of a variation from 7 to 3, 6 to 2, or 5 to 1. This, once more, was to be expected.

(*c*) There is no trace of the influence of contrast in the results. Associations were very few indeed: what there were, were visual,—and usually themselves associatively affective. There was no recognition of the textures from week to week as particular members of the experimental series; though, of course, such stuffs as velvet were known by touch. The stimulus attributes that seemed to the observers to call up the affective judgment were thickness and thinness, coarseness and fineness, roughness and smoothness, stiffness and softness. We can test this by reference to the curves.

First, however, we will look at the judgments made of the scattered ginghams and chambrays. These judgments are numbers 6, 7, 15, 16, 36, 37, 46, 51. We find the values to be:

C.; 3, 4, 3, 4, 4, 4, 5, 3.
H.; 2, 3, 3, 4, 3, 3, 4, 4.
L.; 3, 4, 3, 4, 4, 3, 4, 4.

This constancy, we think, is sufficient to prove our hypothesis correct, when it is considered at what different points of the curves these judgments occur. That we might have been even bolder, methodologically, is shown by the judgments attaching to isolated similars, such as numbers 11 and 41, 42; or 29, 47, 48, 49, 50. We have in these cases:

C.; 2, 2, 3; and 2, 1, 2, 2, 2.
H.; 2, 2, 2; and 2, 1, 2, 2, 2.
L.; 2, 2, 2; and 1, 1, 1, 2, 1.

The absolute likeness of the three curves is no less striking than their relative constancies.

As regards the stimulus qualities, *stiffness* may be predicated especially of numbers 1, 2, 19, 35, 43; *softness* of 11, 18, 30, 38, 40, 41, 42. It will be seen that the curves give high affective values for the latter; low for the former. *Roughness* attaches especially to numbers 1, 12, 13, 14, 17, 20, 35, 46; *smoothness* to 18, 24, 25, 26, 27, 29, 30, 40, 41, 42, 47, 48, 49, 50. It is noticeable, again, that the "roughs" have (on the average) low, the "smooths" high affective

values in all the curves. *Coarseness* is especially characteristic of numbers 1, 2, 19, 35, 43; *fineness* of 9, 30, 31, 32. Though the former is distinctly unpleasant, it will be seen from the curves that the latter does not necessarily carry with it any high degree of pleasantness. Both facts are readily intelligible. Lastly, *thick* were numbers 24, 25, 26, 27, 33, 34, 38, 47, 48, 49, 50; *thin*, 20, 30, 31, 32. Here, too, the affective tone depended on a combination of qualities. Pleasant are 24 to 27, 47 to 50, the thick-smooth series; less pleasant 33, 34 and 38 (thick, but roughish). Again, pleasant is 30 (thin and smooth); less pleasant 31, 32 (thin, but less smooth); still less pleasant 20 (thin and rough).—We do not mean to imply that these eight stimulus qualities are psychological qualities. Psychologically regarded, their differences would be, to a large extent, matters of intensity only.

That thickness or thinness is in itself of little affective weight can be seen from numbers 3, 4, 5 (judged by *C.*, 4, 4, 4; *H.*, 4, 4, 4; *L.*, 3, 4, 4); 21, 22, 23 (*C.*, 4, 4, 4; *H.*, 3, 4, 5; *L.*, 3, 3, 4), and from the series of plushes and velvets. Still, the results show that the observers were right in attributing some influence to this pair of qualities. *H.* said that she preferred thin roughs to thicker; and her judgments are for the former (numbers 12, 13, 14, 20, 46) 3, 3, 2, 4, 4; and for the latter (numbers 1, 17, 35) 6, 5, 4. In the former set, we must remember that 12, 13, 14, though rough, were fine. Indeed, as indicated above, the difficulty of classification of the textures was due to the fact that a single piece usually combined different qualities.

It is difficult to say whether we are here still within the boundaries of psychology, or have crossed the border-line of æsthetics (*cf.* Höffding, *Psychologie in Umrissen*, 1887, p. 286). We incline to the former opinion.

Literature.—We refer the reader, primarily, to the literature section of Cohn's article. General discussions will be found in Wundt, *Vorlesungen*, 2d Ed., pp. 227, 228; *Phys. Psych.*, 4th Ed., ch. x.; Sully, *Human Mind*, II., pp. 49 ff.; Ladd, *Phys. Psych.*, pp. 514 ff.; *Psychology*, pp. 184 ff.; Höffding, *op. cit.*, pp. 285 ff.; etc.

Summary of Results.—(1) We have succeeded in modifying the *serial method* in such a way as to make it applicable to the investigation of the *affective tone of colors*. We publish our modification, however, not in any spirit of dogmatic assertion, but rather with a view to invite criticism both of the method itself and of our analysis of the conscious processes underlying it.

(2) The whole question of the *affective tone of colors* is a

very difficult one. This is due partly to the fact of the unaccustomedness of the affective judgment, partly to that of individual differences, and partly to the fact that the centrally excited influences which meet the incoming stimulus, and which are very strong, differ from time to time in one and the same individual.

(3) We cannot confirm Cohn's rule that the more saturated colors are the pleasanter; *individuals differ* in this respect. Neither can we confirm his generalization that yellow is displeasing to the majority of persons.[1]

(4) No constant affective value can be attached to *black and white backgrounds*. We have found black a little pleasanter, white distinctly pleasanter, and no difference.

(5) As regards preference of *bright and dark saturations*, our observers fall into two groups: one prefers the former, one has no preference. There is no preference for the latter shown.—Here, too, the influence of the backgrounds is individually different.

(6) Experiments with *brightnesses* showed that all alike were just pleasant or not toned. We have no evidence of a preference of the black-white over other brightness contrasts, and no certain evidence of the preference of white over grey.

(7) The few experiments that we made with *pure tones* gave, like those made upon sight, regularity of results for each individual, but differences between individual and individual. In their case, the "modified serial" method ceased to be "serial" at all. The experiments were not continued, as the individual affective judgment, though constant, appeared to be something strained and artificial. This might not be the case with a different method.

(8) We have also found the method, in its modified form, applicable to the sensibilities of *active touch*.

(9) But the *affective tone of active touch* is something far more absolute, *i. e.*, far less dependent upon centrally excited influences, than that of colors and pure tones. The method, therefore, again practically loses its serial nature.

(10) *Stiffness*, *roughness* and *coarseness* of textures were unanimously found unpleasant; *softness* and *smoothness* pleasant. Fineness, thickness and thinness gave variable results.

For other results of detail we must refer the reader to the body of the paper.

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[1] It is difficult to see why yellow, unless so bright as to be painful to the sense-organ, should be so disliked. Yellow is the "warm" color of painters (Wundt, *Phys. Psych.*, 4th Ed., I., p. 568); although its "mood" is that of excitement, it has not the angriness of red; we are greatly accustomed to it, in sunlight and artificial light; children prefer it (Preyer, *Seele des Kindes*, pp. 9 ff.).

A PSYCHOPHYSICAL VOCABULARY.

By E. B. Titchener.

Experimental Psychology was in its origin, and has remained to a considerable extent in its development, a German science. One of the preliminaries to its assimilation by the English-speaking student, therefore, is the understanding of German psychological terms. But their understanding does not necessarily carry with it an Englishing of them. Indeed, there are many factors that make against translation.

In the year 1889—having ploughed through the book in the two previous years—I set to work to write out Wundt's *Physiologische Psychologie* in English, in the hope that its difficulties would be more easily overcome when met in this more familiar garb. I found, as a matter of fact, that they became greater. My reading of English psychology had given me no vocabulary adequate to the German text, and, imperfect as my knowledge of German was, I had fallen into the habit of psychologizing in a mixed jargon of the two languages. Although at the time I persevered with the translation, and have ever since endeavored to keep in mind duplicate vocabularies, nothing but the necessity of teaching and lecturing in English could have prevented a *lapsus* into unmixed German or the English-German mixture. To one trained in a German laboratory—as nine-tenths of the younger psychologists of to-day have been—thinking in German upon psychological questions must be easier than thinking either in English or French. A natural consequence is that technically psychological articles are dotted with German words and phrases, which the writer quite correctly assumes will be intelligible to his readers.

But now that there is growing up an American school of psychology, which promises to be only second in importance to the German, and that the number of home-trained students and future teachers is increasing, it becomes imperatively necessary for us to have at our disposal a working outfit of technical terms in our own language. And here English possesses

over German the great advantage that it can set aside such terms without any fear of their having a popular connotation which could give rise to misunderstanding. An 'impulse' is less liable to carry side meanings than a 'drive' would be, and I can 'cognize' with much better technical effect than I can 'know.' At the same time, this facility of technical coinage or usage is liable to abuse, and I suppose that few psychologists would refuse to admit that such abuse has actually occurred.[1]

It is with these considerations in mind that I submit the following list of technical German words with English renderings. The great majority of them are taken from the indices of Wundt's large book and of Külpe's *Grundriss*. I have made use of such works as Ladd's "Elements of Physiological Psychology," Sanford's "Course in Experimental Psychology," the translations of Ziehen's *Physiologische Psychologie* and Wundt's *Vorlesungen*, etc. The medical dictionaries consulted rendered but little assistance. If many of the words included in the list seem too familiar to call for comment, I would ask the reader to remember that the vocabulary is meant to assist beginners; if any difficult terms have been omitted, their omission is unintentional. All the translations of new or unfamiliar words should be looked on as suggestions only. An asterisk prefixed to the German indicates that I am dissatisfied with its proposed English equivalent. Many of the terms are, in my opinion, altogether unnecessary or undesirable; but they occur and must be translated. Bracketing out, which I at first attempted, seemed likely to result in a special list, open to the charge of arbitrariness of selection, unless very full reasons were given; and these are not here in place. Some discussions follow at the conclusion of the paper.

ABHÄNGIGKEIT, dependency.
*ABKLINGEN, fall.
ABLENKUNG, distraction *or* diversion.
ABSTUFUNGSMETHODEN, gradation methods.
ACCORD, chord (*not* clang).
AEHNLICHKEIT, similarity.
AFFECT, emotion.
AGGLUTINATION, agglutination.

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[1] I am strongly of the opinion that the English nomenclature of psychological processes must be in the main of Latin-Greek origin, and not of 'Saxon.' The demand for a 'Saxon terminology' is simply a collateral result of our Germanization. Which of the natural sciences has a 'Saxon terminology?' Certainly not physics or chemistry. Good discussions of this question will be found in Smith's "Student's English Language;" Lects. VIII, §7; IX, §7; and XII, §4.

ALLGEMEINVORSTELLUNG, general (*better, perhaps, than* abstract) idea.
ANGEBORENE VORSTELLUNG, connate (*if the context be modern theory*) *or* innate (*if the reference be to earlier writers*) idea.
*ANKLINGEN, rise.
*ANLAGE, disposition.
*ANSCHAUUNG, perception.
APPERCEPTION, apperception,
APPERCEPTIVE VERBINDUNG, apperceptive connection.
ASSIMILATION, assimilation.
ASSOCIATIVE VERBINDUNG, associative connection.
AUFRECHT-SEHEN, erect *or* reinverted vision.
AUGENAXE, optical axis.
AUGENMASS, visual space-appreciation *or* space discrimination.
AUGENSCHWARZ = *Eigenlicht, q. v.*
AUSDEHNUNG, extension.
AUSDRUCKSBEWEGUNG, expressive movement (*usually in the particular sense of* expression of emotion).
AUSDRUCKSMETHODE, method of expression (*affective*).
AUSFALLSERSCHEINUNG, phenomenon of abrogation.
AUSSCHALTUNG, exclusion.

BAHNUNG, facilitation.
BEDINGUNG, condition.
BEGEHREN, desire.
BEGIERDE, desire (*best general word; must often be qualified by a particular adjective*).
BEGRIFF, concept.
BEKANNTHEITSQUALITÄT, quality *of contents* as known *or* quality of knownness (*probably better than* familiarity).
BEOBACHTUNGSFEHLER, error of observation.
BEREITSCHAFT, preparedness (*sometimes* disposition).
BERÜHRUNGSASSOCIATION, association by contiguity.
BERÜHRUNGSEMPFINDUNG, sensation of contact.
BEZIEHUNGSGESETZ, law of relativity.
BLICKFELD, field of regard.
BLICKLINIE, line of regard (*practically identical with Gesichtslinie*).
BLICKPUNKT, point of regard (= *Fixationspunkt*).

CENTRAL ERREGTE EMPFINDUNG, centrally excited sensation.
COMBINATIONSTON, combination tone.
COMPLICATION, complication.
CONSTANTER FEHLER, constant error.
CONTRACTIONSEMPFINDUNG, sensation of contraction.
CONTROLVERSUCH, test *or* check experiment.

DAUER, duration.
DECKBILD, congruent image (= *Ganzbild*).
DECKPUNKTE, congruent points (*sometimes* = identical *or* corresponding).
DEUTLICHKEIT, distinctness (*for Külpe* = *Klarheit; for Wundt different. See Klarheit below*).
DIFFERENZIRUNG, differentiation.
DIFFERENZTON, difference tone.
DISPOSITION, disposition.
DISSIMILATION, dissimilation.
DOPPELBILD, double image.
DOPPELTE BERÜHRUNGSEMPFINDUNG, sensation of double contact.
DREHPUNKT, centre of rotation.

DREHSCHWINDEL, rotatory vertigo.
DREIKLANG, common chord, triad (*better, as a rule, than* triple clang).
DRUCKEMPFINDUNG, pressure sensation.
DRUCKPUNKT, pressure point *or* spot.
DUR, major.

EBENMERKLICH, just noticeable, *or* liminal.
EIGENLICHT, intrinsic light (*of the retina*) *or* idio-retinal light.
EINBILDUNG, imagination.
EINFACHHEIT, simplicity.
EINKLANG, unison.
*EINSTELLUNG, predisposition.
EINZELKLANG, single clang *or* note.
ELEMENTE DES BEWUSSTSEINS, conscious elements.
EMPFINDEN, sense.
EMPFINDLICHKEIT, sensitivity.
EMPFINDUNG, sensation.
EMPFINDUNGSKREIS, sensation circle.
ENTFERNUNG, distance.
ERFAHRUNG, experience.
ERHEBUNGSWINKEL, angle of vertical displacement *or* ascensional angle *or* angle of elevation.
ERINNERUNG, recollection, remembrance, memory.
ERINNERUNGSBILD, memorial image *or* idea.
ERKENNEN, cognize.
ERLEBNISS, fact *or* datum of experience.
ERMÜDUNGSEMPFINDUNG, sensation of fatigue.
ERREGBARKEIT, excitability.
ERREGEN, excite.
ERREGUNG, excitation.
ERWARTUNG, expectation.

FARBE, color.
FARBENTON, color-tone.
FARBENGRAD, saturation.
FEHLERMETHODEN, error methods.
FEHLREIZ, error stimulus.
FEINHEIT [*der Unterschiedsempfindlichkeit*], delicacy.
FIXATIONSPUNKT, fixation point.
FREI STEIGENDE [*Vorstellungen*], spontaneous.
FUNDAMENTALFORMEL, fundamental formula.
FUNDAMENTALTABELLE, fundamental table.

GANZBILDER, congruent *or* total images (= *Deckbilder*).
GEBERDENSPRACHE, gesture language.
GEDÄCHTNISS, memory.
GEFÜHL, feeling.
GEFÜHLSTON, affection, affective tone *or* coloring.
GEIST (*in modern usage*), mind.
GEISTESSTÖRUNG, mental derangement.
GELENKEMPFINDUNG, articular sensation.
GEMEINEMPFINDUNG, common sensation.
GEMEINGEFÜHL, common feeling.
*GEMÜTH, feeling and will; the sum-total of affective-conative processes.
GEMÜTHSBEWEGUNG, affective *or* affective-conative process *or* condition.
GEMÜTHSVORGANG, affective *or* affective-conative process.

GEMÜTHSZUSTAND, affective *or* affective-conative state.
GERÄUSCH, noise.
GERÄUSCHHÖHE, noise-pitch.
*GESAMMTVORSTELLUNG, composite *or* complex idea; *or* resultant idea.
GESICHTSLINIE, visual axis *or* line of vision.
GESICHTSWINKEL, visual angle.
GEWÖHNUNG, habituation.
GLANZ, luster.
GLEICHGEWICHTSEMPFINDUNG, sensation of equilibrium.
GLEICHHEIT, parity *or* indistinguishableness (*in the doctrine of association; elsewhere often* = *Aehnlichkeit*).
GOLDENER SCHNITT, golden section.
GRÖSSE, magnitude.
GRUNDEMPFINDUNG, primary *or* fundamental sensation.
GRUNDFARBE, primary color.
GRUNDKLANG, fundamental clang *or* tonic clang.
GRUNDTON, fundamental *or* fundamental tone *or* tonic.

HÄUFIGKEITSMETHODE, method of frequency.
HALBBILD, single image.
HANDLUNG, action.
HAPTIK, haptics.
HAUPTFARBE, principal color.
HAUPTRICHTUNGSSTRAHL, principal line of direction (= *Gesichtslinie*).
HAUTEMPFINDUNG, cutaneous sensation.
HAUTSINN, cutaneous sensibility.
HELLIGKEITSEMPFINDUNG, sensation of brightness.
HEMMUNG, inhibition.
HEMMUNGSWIRKUNG, inhibitory effect *or* action.

INDIFFERENZPUNKT, indifference point (*qualitative*).
INDIFFERENZZEIT, natural *or* normal time.
INNERVATIONSEMPFINDUNG, sensation of innervation.
INTELLECTUELLES GEFÜHL, sentiment (= *the so-called* emotion of relation).
INTENSIVE SENSIBILITÄT, intensive sensibility.
INTERMITTENZTON, tone of intermittence.

KÄLTEPUNKT, cold point *or* spot.
KINÆSTHETISCHE EMPFINDUNG, kinæsthetic sensation.
KLANG, clang (*not* chord).
KLANGEINHEIT, clang unity *or* simplicity.
KLANGFARBE, clang-color *or* timbre.
KLANGVERWANDSCHAFT, clang relationship.
KLARHEIT, plainness (*better, probably, than vividness: see Deutlichkeit, above*); clearness.

LAGEEMPFINDUNG, sensation of position.
LEIDENSCHAFT, passion.
LEITTON, leading tone *or* note.
LEITUNG, conduction.
LEITUNGSBAHN, conduction path; tract.
LICHTEMPFINDUNG, light sensation.
LOCALZEICHEN, local sign (*collective* local signature).
LUST, pleasantness.
LUSTGEFÜHL, pleasure.

MASSFORMEL, formula of measurement.
MASSMETHODEN, measurement methods.
MERKLICHKEIT, noticeableness.
MESSBARKEIT, measurableness.
METHODE DER AEQUIVALENTE, method of equivalents.
METHODE DER EBENMERKLICHEN REIZE, method of just noticeable stimuli.
METHODE DER MINIMALÄNDERUNGEN, method of minimal changes.
METHODE DER MITTLEREN ABSTUFUNGEN, method of mean gradation.
METHODE DER MITTLEREN FEHLER, method of average error.
METHODE DER RICHTIGEN UND FALSCHEN FÄLLE, method of right and wrong cases.
METHODEN DER SINNESEMPFINDLICHKEIT, sensitivity methods.
METHODE DER ÜBERERMKLICHEN UNTERSCHIEDE, method of supraliminal differences.
MIMISCHE REFLEXE, mimetic reflexes.
MITBEWEGUNG, concomitant movement.
MITEMPFINDUNG, concomitant sensation.
MITTELBARE EMPFINDLICHKEIT, indirect *or* mediate sensitivity.
MOLL, minor.
MUSKELEMPFINDUNG, muscle sensation.
MUSKELSINN, muscle sense.
MUSKELSPANNUNGSEMPFINDUNG, sensation of muscular strain.

NACHDAUER, after-duration.
NACHEMPFINDUNG, after-sensation.
NEBENINTERVALL, overtone interval *or* interval of the second order.
NETZHAUTBILD, retinal image.
NORMALREIZ, standard stimulus.
NULLVERSUCH, blank experiment (= *Vexirversuch*).

OBERTON, overtone *or* partial tone.
OPTISCHE TÄUSCHUNG, optical illusion.
ORGANEMPFINDUNG, organic sensation.
ORIENTIRUNG, orientation.
ORTSSINN, sense of locality.

PERIPHERISCH ERREGTE EMPFINDUNG, peripherally excited sensation.
PERSÖNLICHE GLEICHUNG, personal equation.
PHANTASIE, imagination (= *Einbildung*).
PRÄCISIONSMASS, measure of precision.
PSYCHOPHYSISCHES GRUNDGESETZ, psychophysic law *or* primary psychophysical law.

RADDREHUNG, torsion *or* swivel rotation.
RAUHIGKEIT, harshness.
RAUMLAGE, position in space.
RAUMSCHÄTZUNG, spatial estimation.
RAUMSINN DER HAUT, cutaneous space sense.
REAGENT, reagent *or* reactor.
REIHENMETHODE, serial method (*affective*).
REIZ, stimulus.
REIZBARKEIT, irritability *or* susceptibility to stimulus *or* stimulation (*not* excitability).

REIZHÖHE, terminus of (effective) stimulation (*often loosely used as* = last noticeable stimulus; *cf. ebenmerklicher Reiz*).
REIZUMFANG, range of (effective) stimulation.
REIZUNG, stimulation.
REPRODUCIRBARKEIT, reproductivity (*passive*).
REPRODUCTION, reproduction.
REPRODUCTIONSFÄHIGKEIT, = *Reproducirbarkeit* (*passive*).
REPRODUCTIONSGRUNDLAGE, material of reproduction.
REPRODUCTIONSMOTIV, incentive to reproduction.
REPRODUCTIONSTENDENZ, liability of reproduction.
REPRODUCTIONSTREUE, fidelity of reproduction.
RICHTLINIE, right line.
RICHTUNGSSTRAHLEN, lines of direction.
RINDENBLINDHEIT, cortical blindness.
ROLLUNG = *Raddrehung*, *q. v.*

SÄTTIGUNG, saturation.
SCHÄTZUNGSFEHLER, error of estimation.
SCHALL, sound.
SCHMERZ, pain.
SCHWANKUNGEN DER AUFMERKSAMKEIT, oscillations *or* fluctuations of the attention.
SCHWEBUNGEN, beats.
SCHWELLE, limen.
SCHWINGUNGSZAHL, vibration rate.
SEELE (*in modern usage*), mind.
SEELENBLINDHEIT, mental *or* psychical blindness.
SEHFELD, field of vision.
SEHNENEMPFINDUNG, tendinous sensation.
SEITENWENDUNGSWINKEL, angle of lateral displacement.
SIGNALREIZ, warning stimulus, ready signal.
SINN, sense, sensibility, modality.
SINNESEMPFINDLICHKEIT, modal sensitivity.
SINNESEMPFINDUNG, sensation of special sense.
SINNESPUNKT, sensitive point *or* spot.
SINNLICHES GEFÜHL, sense-feeling *or* peripherally excited feeling.
SPANNUNGSEMPFINDUNG, sensation of strain.
SPIEGELUNG, reflexion *or* mirroring.
STATISCHER SINN, static sense.
STIMMUNG, mood.
STOSSTON, beat tone.
STREBEN, effort.
SUBJECTIVE BETONUNG, subjective accentuation.

TASTEMPFINDUNG, sensation of touch *or* tactual sensation.
TIEFENVORSTELLUNG, idea of depth *or* the third dimension.
TONHÖHE, pitch *or* tonal quality.
TONVERSCHMELZUNG, tonal fusion.
TRIEB, impulse.
TRIEBBEWEGUNG, impulsive movement.

UEBERMERKLICH, supraliminal.
UNLUST, unpleasantness.
UNLUSTGEFÜHL, unpleasant feeling.
UNTERSCHIEDSEMPFINDLICHKEIT, sensible discrimination (*better than* difference sensitivity).
UNTERSCHIEDSHYPOTHESE, difference hypothesis.
UNTERSCHIEDSSCHWELLE, difference limen *or* limen of difference.

UNWISSENTLICHES VERFAHREN, procedure without knowledge.

VERBINDUNG, connection.
VERGLEICHSREIZ, stimulus of comparison.
VERHÄLTNISSHYPOTHESE, relation hypothesis.
VERKNÜPFUNG, conjunction *or* colligation (*better than* combination).
VERSCHMELZUNG, fusion (*better than* blending).
VEXIRVERSUCH, puzzle experiment (*not so good as Nullversuch*, *q. v.*).
VISIRLINIE, sighting line *or* line of aim.
VÖLKERPSYCHOLOGIE, social psychology *or* psychology of nations.
VORSTELLUNG, idea.

WÄRMEPUNKT, heat point *or* spot.
WAHL, choice *or* selection.
WAHNVORSTELLUNG, delusive idea.
WAHRNEHMUNG, perception.
WAHRSCHEINLICHER FEHLER, probable error.
WETTSTREIT DER SEHFELDER, retinal rivalry.
WIDERSTANDSEMPFINDUNG, sensation of resistance.
WIEDERERKENNEN, recognize.
WILLE, will.
WILLENSHANDLUNG, voluntary action.
WILLKÜRHANDLUNG, selective action.
WISSENTLICHES VERFAHREN, procedure with knowledge.

ZEITFEHLER, time error.
ZEITHOF, time fringe.
ZEITLAGE, position in time *or* temporal position.
ZEITORDUNG, temporal arrangement *or* disposition.
ZEITSINN, time sense.
ZEITVERSCHIEBUNG, time *or* temporal displacement.
ZERSTREUTHEIT, absent-mindedness *or* distraction.
ZERSTREUUNGSBILD, dispersion *or* diffusion image.
ZUSAMMENKLANG, compound clang.
ZUSTAND, state (*not* condition; *cf. Bedingung*).
ZWANGS-, compulsory.
ZWEITHEILUNG, dichotomy.

The discussion of the terms to which an asterisk is prefixed can hardly be anything more than an expression of despair as regards the discovery of single equivalents in English.

1. *Anklingen* and *Abklingen*.—For the *farbiges Abklingen der Nachbilder*, the phrase *flight of colors* seems fairly good. For the terms themselves, *rise* and *fall* are, perhaps, the most universally applicable translations.

2. *Anlage* and *Einstellung*.—None of the words proposed by the morphologists (*proton*, *rudiment*, *primule*, *blast*, *incept*, etc.) seems to fit the psychology of *Anlage*. And *disposition* and *predisposition* are too vague to be really adequate.

3. *Anschauung* and *Warhnehmung*.—I do not know how these two terms can be distinguished.

4. *Gemüth* should have a single equivalent, but I cannot find one.

5. *Gesammtvorstellung*, *Allgemeinvorstellung*, etc.—These terms must be translated according to context. They are, for the most part, used in specific senses by different authors.

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF WELLESLEY COLLEGE.

Communicated by MARY WHITON CALKINS.

I.—THE "CONTINUED STORY."

By MABEL W. LEAROYD,

With the assistance of MAUDE L. TAYLOR.

This paper briefly states the results of an attempt to discover something of the prevalence and nature of "continued stories"—imaginary and usually unwritten narratives, prolonged by their inventors, so that they go on through several weeks, months, or years. In such stories the same characters reappear in different situations and predicaments, growing often in years and in intellect. The stories themselves are cherished with a peculiar fondness, and always regarded by the authors as an especially sacred mental possession, to be shared only, if at all, with very sympathizing friends. These stories have been classified, by one of the most versatile of "continued-story-inventors," according to six main types: (1) The fairy tale and (2) the tale of martyrdom—both characteristic of early childhood; (3) the romantic and (4) the adventurous story—both belonging to late childhood and to early youth; (5) the ideal type, confined to no particular period; and (6) the practical story—characteristic of maturer years.

This paper is based on the records of 114 children in New England schools; of 214 young women, students at Wellesley College, and at the College for Women of Brown University; and of 148 men, most of them students at Harvard and in Iowa College, but a few of them in business and several of them in middle life. The following table shows the number of those who have at some time possessed a continued story:

TABLE. PREVALENCE OF CONTINUED STORY.

Age of Subjects.	ANSWERS TO QUESTION, "HAVE YOU A CONTINUED STORY?"						Sum Total.
	WOMEN AND GIRLS.			MEN AND BOYS.			
	Yes.	No and Doubtful.	Total.	Yes.	No and Doubtful.	Total.	
Adults,	100 (46.7%)	114 (53.2%)	214	20 (13.5%)	128 (86.4%)	148	352
Children,	41 (68.3%)	21 (31.7%)	62	29 (55.7%)	23 (44.2%)	52	114

From this summary it appears that nearly two-thirds of the 114 children who answered the question have continued stories, but that the proportion of affirmative answers is slightly greater among the girls. The insignificance of this difference is noticeable, and seems to suggest that the greater difference between the records of the men and the women is perhaps a result of different training. The children were members of the intermediate grammar school grades, and averaged twelve years of age. (The nature of a continued story was carefully explained to them, and all the detailed questions were asked, though the answers were not recorded). Less than a third as many men as women have continued stories, but the stories of the men are as vivid, as pronounced, and as significant as any of those recorded. One young man, for instance, reports that in his seventeenth and eighteenth years he spent six hours a day in the invention of his stories, which he characterizes as "baneful bothers, wasting time, and destroying activity even to eating and rising."

From the 93 detailed affirmative records received from adults, the following conclusions may be reached: With very few exceptions, the stories begin in childhood, and several subjects date them in their fourth year. The experience, however, is not wholly a childish one, for only 34 (of the 87 subjects who replied to this question), that is, only one-third, have lost or dropped the stories. Even a man of seventy years still carries them on. They may begin, also, in adult years. The number of stories of a given subject varies from "one," through "several," to "innumerable," or "hundreds." The length varies from weeks to years: some stories have continued since early childhood, and two-thirds of the subjects (64) have had stories with a duration of years.

With almost all the authors, comparative solitude favors the growth of the story. Many subjects, therefore, mention the hour before falling asleep as peculiarly sacred to the

"continued story," and others speak of lonely walks, of monotonous or solitary occupations like "hoeing corn," or "driving the cows." One young man says: "The story was always thought of at night, when I took long walks, often well into the morning."

The starting point in all but 12 cases is an assignable experience or a book actually read. One young woman says: "For many years I used to get the characters, station in life, place of residence, and even the remotest particulars, by telling fortunes on daisies. Then using this as a basis, I would mentally continue the stories."

In only one-fifth (18) of the stories are the characters exclusively fictitious, while in about half (47) they are entirely from real life. In three-fourths of them the author plays a very prominent part. "The heroine of everything," one subject says of herself. Often this hero is an idealized self. Thus one subject writes: "I remember in one of my stories introducing myself just as I was, and also this idealized 'I.'" Two-thirds (64) of the stories are said to "embody an ideal."

Some of the tales are recognized as distinctly helpful; others are chiefly sources of amusement. Occasionally the stories are said to be really harmful. So one student writes: "I realized that it kept me awake too long and * * * sometimes made me absent-minded, so I deliberately made myself think about other and real things * * * and gradually my interest in my story faded away." Entirely opposed to this is the experience of some one who says, "I have kept it up in order to keep my mind on one subject before going to sleep, and so as not to run over and over the events of the day."

The stories sometimes gain a great vividness, and almost the force of an illusion. So one subject says, "The story was so real that often in my dreams I was not myself, but the story character, and surrounded by the other story people." Another writes, "If I have said or done something which I wish I had not, I can, by continuing this story, make it seem as if I had never said or done it."

Most of the characters show a certain devolopment; they "grow as I grow," as one writer says. This seems to be the essential difference between the continued and the short story: the former is more intimately related to the life of its author. So one subject writes: "The long story is vitally connected with my nature." The accentuation of the emotional element in the continued stories suggests the same connection, and, on the other hand, the distinction is shown by the occasional recognition that the short stories have a greater literary value. One subject writes: "Short stories

have a greater variety of character and incident;" another says, "If I ever hit upon a fairly good plot the story ceases to be continued." Evidently the longer story follows the growth of the author's plans and purposes; embodies in concrete form his changing ideals. For this reason, one of the acutest of the observers who has answered the questions concerning her story pronounces the long story decidedly more helpful and more wholesome than the shorter ones.

It has already been suggested that the essence of the continued story, as of the more evanescent, lies in the opposing yet interacting tendencies of every individual toward self-assertion and toward imitation. The experience of the girl who says that the origin of the stories, so far as she can tell, was her "firm belief" in her "own powers," may supplement, not contradict, the testimony of the man who says that he likes "to copy a result," and that he thinks his stories "the result of a tendency toward imitation." Even the following experience, with all its self-assertion, obviously requires imitation:—

"I think the story was a continuous and progressive embodiment of my ambitions and ideals. In childhood it was popularity or skill in games, or fine possessions, in which I revelled, in imaginary conversations with other children, in which they always recognized me as superior to them, and in which I, too, had a comfortable sense of superiority. As I got older, I was more apt to picture myself as triumphant in wondrous feats of scholarship in gaining school honors. And finally I used to see myself as a teacher, and the imaginary conversations would be with the class or with the school officials. All the stories represented real ambitions which were always fulfilled, and the chief pleasure of the vision seems to have been unbounded conceit, for characters besides myself apparently existed chiefly to be witnesses of my success and to be a little envious of it."

The story which follows, illustrates admirably many of the most typical features of the "continued story:"—

"When a boy about ten years old, I read the lives of Alexander the Great and Napoleon. Then I soon began to construct these stories. I was always the hero and * * * became a great general at the head of a mighty army. I would describe my marshals and armaments, the plans of the battles and then the victorious march homeward. I always became emperor of France and conqueror of Europe, and then had a long reign filled with all kinds of interesting things. I always pictured the great funeral that followed my death and a people in mourning. I would describe in the minutest detail my children, their names, their exercises,

their studies, their marriage and the beginning of their careers. I described my home, the lakes, drives, and always my study. There was never any break. The story flowed right on, and if my attention was called away, I was always uneasy until I could begin again to weave it. I would always lie awake as long as I could, after going to bed, to work on it. I always brought my friends in and provided well for them.

"At the age of fourteen, I began to read the lives of men like Webster, Clay, Lincoln, etc. Then the story changed. My education was such as fitted me for an orator and statesman. I always became governor of my state, congressman, senator, and finally president. Every step and all my relations to friends were minutely described. I usually ended up by becoming president of a World's Congress of Peace. As soon as I had died I always started another story."

II.—Synæsthesia.[1]

By Mary Whiton Calkins.

The study of the varying forms of persisting abnormal association, usually known as "colored-hearing" and "forms," but grouped together by Theodore Flournoy, under the convenient name *Synæsthesia*, has hardly, as yet, completed the stage of scientific observation. The physiologists, with their guesses of intertwined nerve fibres, and Mr. Myers, with his prompt application of the subliminal consciousness theory, are avowedly dealing with unverified hypotheses; on the other hand, the reports of particular cases are apt to overlook the ordinary forms of the phenomenon and to disregard the frequency of the experience. For the purpose, then, of a wide yet careful survey of these phenomena of consciousness, assuming no certainty of any important theoretical outcome, it has seemed worth while to continue the statistical study of synæsthesia begun two years ago at Wellesley College. The investigation has the advantage of reaching a large number of individuals of the same sex and of about the same age, but coming from different localities and homes. The artificiality of many statistical inquiries has been avoided so far as possible, by making the questions both concrete and simple. Some of the questions of the former study[2] are here not at all considered, either because of the practical unanimity of the earlier

[1] A continuation of the Wellesley College Study of Colored-Hearing and of Forms.

[2] "A Statistical Study of Pseudo-chromesthesia and of Mental Forms." American Journal of Psychology, Vol. V, 4.

answers or because of the difficulty of gaining accurate replies.

The most general, positive conclusion of the study is the virtual demonstration of the stability of the experience. Nearly two hundred persons, questioned a second time, usually a year, always several months after the first inquiry, and without previous intimation of this verification, have been found, with only one exception, to possess the photisms or the forms at the end as at the beginning of the time, and in the same general form of the mental habit. Often the shades of color and the turns of the forms are exactly the same; in other cases, slight changes or omissions in the list of colors, or altered curves in the forms, show a close connection between colors or forms and the intervening experience of the subject, but in general type the phenomenon is an abiding one. This proof in the case of the first two canvasses of the constancy of the synæsthesia, has made it possible to omit in the last investigation the tedious process of verification, except in reference to letter-color, in which changes seem especially often to occur.

The only particular in which the results of the three canvasses seem to contradict each other is with regard to the prevalence of synæsthesia, whose per cent. of occurrence increases with each year's report. In the summary which follows, *P.* represents photisms (that is, cases of pseudo-chromesthesia); *F.* stands for forms, and includes those forms for single words, figures and objects, which Mr. Flournoy names symbols; *D.* designates not only the explicit dramatization of letters and numerals, but cases of particular fondness for especial ones; the figures under this head are given only for 1894, since in 1892 the questions were not asked, while in 1893 they were inexactly formulated.

The larger per cents. are far more likely to represent the actual frequency of synæsthesia, for the reason that the proportion increases exactly in accordance with the increasing care of the investigation. The first canvass attempted too much in trying to reach the whole college, and among the 200 who failed to respond there certainly were many who avoided the questioners in order to rid themselves of the troublesome necessity of answering. In 1893 every member of the freshman class was questioned, but the preliminary inquiry was by circular, and the traditional objection to answering statistical inquiries may be responsible for many careless, negative replies. In 1894 the class was addressed, the purpose of the investigation was explained, and the preliminary questions were answered before the students left the room. The more detailed inquiry was made either by circu-

SUMMARY I.

Frequency of Synæsthesia.

Canvass of	Subjects with[1]			Subjects with[2]			Total Subjects with Synæsthesia.	Subjects with no Synæsthesia.	Total Subjects.
	P.	F.	D.	P. & F. (& D.)	OtherCombinations.	P. or F. or D.			
'92	35 (= 6.66%)	65 (= 12.38%)		18		64	82 (= 15.61%)	443	525
'93	36 (= 16.82%)	56 (= 26.16%)		23		48	71 (= 33.17%)	143	214
'94	56 (= 23.33%)	115 (= 47.5%)	83 (= 34.58%)	38	45	62	145 (=60.41%)	95	240
Total				79	45	174	298	681	979

[1] The figures under this heading can not be counted towards the total, because the same subject may be represented in more than one column.

[2] In the figures under this head each subject is represented but once; the sum of these figures makes up the total.

lar or by personal interview. The investigation will be continued for several years, in order to obtain more material for decision, but at its present stage it seems to justify the opinion that of every ten persons five at least have some peculiar, fixed form of mental imagery, and that of these five two are likely to have photisms[1] and four to possess some mental form, while three must admit some other kind of apparently erratic association.

It is fair to add the figures of a canvass with very different results. Miss L. A. Williams questioned about 250 pupils of the Trenton, N. J., Normal School. Of these about ten per cent. were young men, and the average age of all was a little under eighteen. Only five cases (2 per cent.) of colored-hearing and six cases (2.4 per cent) of forms were found. I can explain this proportion, so much less than that of any other computation, only by reference to two facts: that 110 of the subjects "answered the questions hastily in time taken from other work;" and that some indications of the tendency "were not reported." Yet this report of a careful observer is certainly worthy of consideration.

A canvass among older people might, also, yield different results, but it should be observed that few of our subjects are conscious of any lessening of the experience. This is shown by

SUMMARY II.[2]

	INCREASE.			DECREASE.			Neither	Both	No Ans.	Total.
	Sure.	?	Total.	Sure.	?	Total.				
P.	20	8	28	14	1	15	42	0	7	92[3]
F.	38	6	44	12	4	16	90	4	17	171[3]
Total			72			31	132	4	24	263

The general character of the cases of synæsthesia appears from the following classifications:—

[1] Cf. Galton, Bleuler u. Lehmann and Flournoy for much lower estimates: —$\frac{1}{8}$ and $\frac{1}{6}$.

[2] This summany, like all those which follow, considers only the records of 1893 and 1894.

[3] 92 is the number of subjects who have photisms; 171 is the number of those who have forms; evidently the same subject may be represented in both totals.

SUMMARY III.

Varieties of Forms.

	Sure.	?	Total.
Month-forms,	141		141
Number-forms,	119		119
Day-of-week forms,	105		105
Century-forms,	48	1	49
Other forms,	95	1	96
Total forms,	508	2	510

These records, therefore, corroborate the earlier ones with regard to the order of frequency of the different forms. Month-forms lead, closely followed by number forms. Under the name "other forms" are grouped alphabet-forms; a few hour-forms; a form distinct from the number-form, which progresses from the decimals through units, tens, hundreds and the like to dexillions; a form for sharps and flats in music; two prayer forms, one for the Lord's prayer and one with a variable curve at the end, which alters with the changing character of the original petitions; and finally several symbols for places, months and numerals, with one irregular, closed curve, representing a "sudden shriek."

SUMMARY IV.

Varieties of Pseudo-chromesthesia.

With.		Sure.	?	Total.
Letters	Vowels only in 10 cases.	43	1	44
	Consonants only in 4 cases.			
	Both, in 30 cases.			
Words,		72		72
Music,		63	1	64
Numerals,		14		14
Odors,		1		1
Tastes,		6	2	8
Touches,		6	2	8
Pain,		1		1
Total forms of psuedo-chromesthesia,		206	6	212

The frequency of consonant-color still far exceeds that of Galton's and of Flournoy's subjects. The latter[1] reports 46 subjects with consonant-color to 247 with vowel-color (554 to 1,076 single cases); while this Wellesley table gives 34 subjects and 225 cases of consonant-color to 40 subjects and 134 cases of vowel-color. No table of colors is given, because not all the records have been verified. The result, however, of these records and a study of all the attempted reductions of letter-color to any rule, lead almost inevitably to the conclusion that the associations vary freely with different

[1] Flournoy, "Des Phénomènes de Synopsie," pp. 90-91.

subjects. Even Flournoy's modest "loi de clarté"[1] finds no corroboration in our records.

The noticeable frequency of i = black and o = white, in the 1892 records, fades to a mere preference for these associations over any other (9 in 26 cases of i = black or "dark," 10 in 28 cases of o = white or "pale"). On the other hand, most of the cases of music-color conform to the well-established rule: photisms for the high notes are light and those for the low notes are dark.

Detailed questions were asked, to discover, if possible, different photisms for different sounds of the same vowels, but the answers disclose a general sameness of color, with occasional changes in shade for the photisms of the long and short sounds of the same vowel. This seems to show a less common connection than is often supposed between the sound of a letter or a word and the color. This conclusion, however, is of doubtful value, for when once the letter is learned, its different sounds and shapes are almost indissolubly connected,[2] so that the color of the most important vowel-sound might conveniently stand for the letter as a whole, for every form as well as for every sound of it, even displacing previous photisms with the other sounds. The prominence of sound-color over sight-color, but the likelihood that both the sound and the appearance, which are parts of the complex letter-consciousness, are effective in the association, are shown by

SUMMARY V.

Connection of Color with Sound and with Shape.

COLOR, WHEN LETTER, WORD, MUSIC, ETC., IS							
Heard (only).		Seen (only).		Both.		No Ans.	Total.
28	9	3	3	56	5	5	92

The figures in the right hand columns indicate cases which are not counted in the totals, because represented in still another column. This occurs when different photisms of the same subject are occasioned by different stimuli.

The remaining results of the study of pseudo-chromesthesia are grouped together, with reference to their bearing on the attempted explanation of the experience. From these records

[1] *Op. cit.*, p. 66.
[2] Cf. Flournoy, *op. cit.*, pp. 48-49.

it is clear that some, at least, of these photisms must be explained as due to natural associations. The instances in which these explanations are definitely given are summarized below.

SUMMARY VI.

Explanation of Pseudo-chromesthesia.

Nature of Pseudo-chromesthesia.	THE EXPLANATION IS						Total Explanations.	No Explanations.	No Ans.	Total Cases.
	THROUGH ACT. OCCURRENCE.		EMOT'L.		BOTH.					
	Full.	Partial	Full.	Partial.	Full.	Partial.				
Letter-color,	2	3	0	0	0	0	5	28	11	44
Word-color,	12	12	4		8	1	37	26	9	72
Music-color,	5	1	15	9	2	3	3	19	10	64
Color with Numerals,	0		0		0		0	0	14	14
Color with Touches, Tastes, Odors, Pain,	0		0		0		0	0	18	18
Total,	19	16	19	9	10	4	77	73	62	212

It should be added that among 40 cases of the occurrence of both letter and word-color, there are 13 in which the word-color is known to have been earlier in occurrence than the letter-color, while in only three cases the letter-color is remembered as earlier. From the summary it already appears that word-color is very susceptible of explanation through some actual experience, and, in fact, 10 of these 13 cases are wholly or partly explained by the subjects. It is possible, therefore, that these instances of letter-color are due to forgotten connection with natural word-associations.[1]

The prominence of association through emotional experience is marked, especially in regard to music-color. This agrees with the results of the earlier canvass[2] and seems to indicate that here, as in the case of so many psychological problems, the ultimate solution may be in unanalyzable terms of feeling. "Gay disposition, gay color," says one subject; "if I admire name or character, it is through liking for color." "It's

[1] Cf. *op. cit.* AMERICAN JOURNAL OF PSYCHOLOGY, V, 4, p. 447.
[2] Cf. *op. cit.*, AMERICAN JOURNAL OF PSYCHOLOGY, V, 4, p. 446.

the feeling I get from my music," another says; "I always imagine those colors with those emotions." "Things which make me happy," writes a third, "are always light pinks, blues and yellows, while sad things are always dark."

Many of these explanations are, of course, fragmentary and incomplete, and it is possible that some are mere instances of paramnesia or explanations after the event. It is just as likely, however, that many instances of the origin through ordinary association have been forgotten. Certainly the existence of any such natural explanations diminishes the necessity and the probability of the theory of physiological abnormality. Cases in which the experience is definitely useful or pleasant also favor the natural theory, and these are not inconsiderable in number.

SUMMARY VII.

Utility and Pleasurableness of Pseudo-chromesthesia.

	YES.		NO.		Neither.	Both.	No Ans.	Total.
	Sure.	?	Sure.	?				
The subject's memory is helped,	12	4	50	7			19	92
The subject finds pleasure in "colored-hearing,"	44	7	3	1	24	5	8	92

There are few cases of assisted memory, but some of these are very marked, as, for instance, that of the student who says, "If I hear an opera, I can come home and almost play it by colors; I know what chords make a given combination of colors." The pleasurableness of the experience is very common, and might be a reason for the perpetuation of a color and sound association accidentally formed.

For the physiological theory the strongest argument is the undoubted hereditary tendency of synæsthesia. The answers to the questions bearing on this point are not summarized, since the subjects, who very likely have never heard of any colored-hearing or forms among members of their families, are so likely to reply by a rash "no" or by a misleading "doubtful." The frequent repetition of the experience within a family and its continuance from one generation to another are acknowledged, however, by all observers, and certainly suggest the existence of cerebral peculiarities. But these may be the result or the accompaniment, not the cause, of the synæsthesia, which may still be referred to use-

ful or pleasant associations. Cases in which the pseudo-chromesthesia rises to the stage of hallucination are also such as lend themselves readily to a cerebral explanation. These are presented in the next table, but it should be observed that the statistical method, even when supplemented, as in this case, by simple experiments, is peculiarly unfitted for an investigation of hallucination, since the questions themselves may suggest a false memory of hallucination; even so, the affirmative answers to these questions are few. They include cases in which a page seems to the reader actually tinged with the shade of the "colored" letter or word, as when one subject says, "The paper grows orange-pink as I look at *a* on a page;" and instances of after-images, like that of the student who answers, "Sometimes when I look up very quickly, I have the same color [as that of letters or word], when I don't want to have it at all."

It might also be urged that instances in which the color is in very distinct form and is very definitely located are more likely than the cases of shadowy and vague color to involve peculiar cerebral accompaniment. This conclusion is of questionable validity, but the figures bearing on these considerations are added and show that the color is usually in indistinct form, but almost always definitely located—generally, it may be added, in front of the subject.

SUMMARY VIII.

Form and Location of Color. *Hallucination.*

	Definite.	Indefinite.	No Ans.	Total.	Yes.			No.			No Ans.	Total.
					Sure.	?	Total	Sure.	?	Total		
Form,	31	47	14	92	13	8	21	54	6	60	11	92
Location,	64	15	13	92								

In conclusion, therefore, it may be said that our results do not demonstrate either theory of pseudo-chromesthesia to the exclusion of the other, but that they favor the "psychological" explanation through natural association, by proving the existence of some cases, at least, which demand this explanation.

Among the 171 persons who have forms, we find only 4 who are certain of any hallucination and 7 who answer by a doubtful affirmative. One of the rare cases in which the form is a positive hindrance seems to approach in its

vividness the plane of illusion: of a number form, which is a spiral prolonged to infinity, the possessor writes, "[my form] makes mathematics harder, for, *e. g.*, in algebra, when I must substitute ∞ throughout an equation, I get so lost in the ∞ that I can't get at it at all."

The explanations and the cases of usefulness are, however, very frequent; the shapes are in most cases familiar, usually circles, rectangles or lines; the turns of the number-forms in the great majority of cases are at the most prominent numerals, the 5's, the 10's and the 12's.[1] So it is in the highest degree probable that most of these forms originate in the self-helping, topographical imagination of children introduced to the intricacies of number and word series. The frequency of slight variations in the forms from year to year—bends to right instead of to left, or upward rather than downward—favors the theory of natural association by showing, as has been said, a connection with the adult, as well as with the childhood experience, a certain sensitiveness to changes in the methods of thought and of life. The physiological theory can hardly account, in so simple a manner, for these unimportant yet definite alterations.

SUMMARY IX.

Explanation and Utility of Forms.

Forms have	YES.			NO.			No Ans.	Total.
	Sure.	?	Total Affirmative.	No.	Hindrance	Total Negative.		
Explanation,	98	31	129 (25.29%)	318		318 (=62.35%)	63	510
Utility,	182	27	209 (40.98%)	243	6	249 (=48.82%)	52	510
Explanation, or Utility, or Both.			278 (54.50%)			220 (43.13%)	12	510

The proportion of definite explanations is thus considerably greater than that of the earlier study,[2] and in view of the great probability of forgotten origins, the natural theory of forms seems overwhelmingly probable. "The nature of the month-form," one student writes, "is probably due to the

[1] Cf. *op. cit.*, AMERICAN JOURNAL OF PSYCHOLOGY, V, 4, p. 449.
[2] *Op. cit.*, AMERICAN JOURNAL OF PSYCHOLOGY, V, 4, p. 448.

nature of my school work. From January to June there is a gradual letting up of the strain; July and August are the calm months, and with September begins the up-hill work." "My number-form," says another, "I can trace back to a game which I played in childhood. The figures were in small blocks." A third explanation refers the origin of the form to kindergarten days: "My number-form originates, I think, in those frames with colored beads strung upon wires, by means of which children are taught to count, add, subtract, etc."

The testimonies to the utility of the forms are no less explicit. These which follow are representative: "The only way I can remember dates is that other dates are proportional to them (on a form of concentric circles). I remember 1,625 because it is at an angle of 30° from the present." "I am almost entirely dependent on my form for remembering dates, appointments, people and places; and * * * I think it would be impossible for me to add the smallest numbers without the aid of my number form." "My alphabet-form helps very much in type-setting." "When I said I would come here, I 'put it down' on my form."

The significant number of those who believe that they are helped by their forms to memorize facts, to remember dates and to perform mathematical operations, emphasizes the wisdom of such educational use of forms as has already been made by Miss Adelia Hornbrook.[1] Indeed, the use of charts and of diagrams is in itself a suggestion of mental forms, for calendars and primer pages lie at the basis of many month, week and alphabet forms. To make these suggestions more definite, and, in particular, to impress the child's memory, as Miss Hornbrook does, with some simple number-form, seems a reasonable, pedagogical application of these forms. Such aid to the visual imagination might not aid the essentially "ear-minded" children, but it could do no harm unless unduly pressed.

The elaborate dramatization of letters, numerals and musical notes,[2] by which they are endowed with physical and with psychical characteristics, so that they often become actors in entire little dramas among themselves,—this complex experience may probably be referred to the commoner and simpler phenomenon of especial like or dislike for certain letters or numbers. All these cases may be classified as follows:—

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[1] *Educational Review*, V, p. 467.
[2] *Op. cit.*, AMERICAN JOURNAL OF PSYCHOLOGY, V, 4, p. 454.

SUMMARY X.

Personification.

Forms of Personification.	Yes.	No.	Total.
Like or Dislike,	75	8	83
Dramatization,	46	37	83

Examining more closely these instances of like and dislike, we find that there are fifty per cent. more such associations with the numerals than with the letters, which indicates that the numerals, as objects of more intense intellectual effort, are more likely to become factors of emotional association. Still more carefully observed, these numerical associations disclose the existence of a marked preference for the even numbers.

SUMMARY XI.

Even and Odd Numbers.

Numbers.	EVEN NUMBERS.			ODD NUMBERS.			Indefinite Ans.	Letters only Liked, etc.	Total Liked and Disliked.
	Even Only.	Even with Odd.	Total.	Odd Only.	Odd with Even.	Total.			
Liked,	22	12	34	12		12	21	8	75
Disliked,	4		4	38	3	41	14	16	75

There seems to be a special fondness for 2, and—among the odd numbers—for 5, but a common aversion for prime numbers like 7, 11 and 13. One would almost certainly infer that these feelings have their root in the actual experience of facility in the use of even numbers, and of difficulties with the unyielding indivisibility of prime numbers, and the explicit testimony of one-fourth of our subjects confirms this view. In these cases of personification, therefore, as well as in the other forms of synæsthesia, the "psychological" theory seems the simpler and the more probable.

QUESTIONS ON SYNÆSTHESIA.

These questions are based upon a list formulated after the careful study of more than 80 records of synæsthesia. They have been re-cast after the experience gained by using them during two years,

for 200 subjects, and after the addition of questions suggested by Flournoy's and by Gruber's classification.

Questions which seem to the writer of secondary importance in the theoretical consideration of the subject, though necessary to a complete description, are starred.

It is suggested that the first step in a systematic investigation of synæsthesia should be to ask the preliminary questions which demand simple "Yes" and "No" answers. When the replies have been sifted, the more detailed questions may be sent to all who have answered affirmatively. Canvasses of men's colleges, or college classes, of associations of people in middle life, of schools of children and young people, and of the accidentally blind and deaf, would yield especially valuable results. Materials and more detailed suggestions for such inquiries will be supplied, and the results gladly received by

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SYNÆSTHESIA.

PRELIMINARY QUESTIONS.

Answer by "Yes," "Yes?", or "No." Do not fail to answer "Yes?" *not* "No," if in any doubt.

I. Do you think of particular colors in connection with letters of the alphabet, or numerals, or proper names, or musical sounds, or in any other unusual connection?

II. Do you think of numerals, or names of months, days or years, or of any series of words, as arranged in particular shapes, like circles, squares, zig-zags, or very long lines?

III. Do single numerals, letters, musical notes, etc., make you think of different shapes?

IV. *a.* Do you especially like or dislike any numerals, letters, etc.?

b. Do numerals, letters, etc., seem to you to be like people?

DETAILED QUESTIONS.

Note,—Many of these questions may be answered by "Yes" or "No," but fuller replies are preferable. It is hoped that all questions will be answered, but the less important ones are starred.

A. Pseudo-chromesthesia.

I. Do you habitually or frequently "seem to see" colors or variations of light and shade, in connection with certain letters, words, objects, sounds, or other sensations? If so, mention the colors connected,

a. With letters.

1. With vowels.

ā (as in fāte), ă (făt), ä (fär).
ē (" mē), ĕ (mĕt).
ī (" mīne), ĭ (pĭn).
ō (" mōte), ŏ (nŏt).
o͞o (" mo͞on).
ū (" mūte), ŭ (tŭb).
ȳ (" tȳpe), y̆ (sy̆mbol).

2. With diphthongs.
   æ au ay ei ew œ ou
   ai aw eu ey oi ow.
3. With consonants.
   b d
   c f
   etc. (Mention all cases.)

b. With words.
1. Names of people. (Mention instances.)
2. Names of places. (Mention instances.)
3. *a.* Names of months. (Mention all cases.)
   b. Names of days of week. (Mention all cases.)
4. Common terms.
   a. With all words, or with a few?
   b. With any particular parts of speech?
   c. With abstract terms?

c. With sounds.
1. With musical sounds.
   a. Different pitches.
      (1) High.
      (2) Low.
   b. Different intensities.
      (1) Loud.
      (2) Soft.
   c. Different keys. (Mention all cases.)
   d. Different instruments, *e. g.*, violin, piano. (Mention all cases.)
   e. Different composers, *e. g.*, Chopin, Handel.
   f. Different pieces of music.
2. With noises. (Mention all cases.)

d. With numerals, *e. g.*, 1, 3, 9. (Mention all cases.)
e. With pictures or objects, which are
1. Still.
2. In motion.

f. With tastes. (Mention all cases.)
g. With odors. (Mention all cases.)
h. With skin sensations. (Mention all cases.)
1. Contact.
2. Pressure.
3. Temperature.
4. Sensations of movements.

k. With pains. (Mention all cases.)

Answer questions II and III with reference to each sort of color; that for letters, words, music, numerals, tastes, etc.

*II. a. Does the color appear
1. *Only* when the letter (word, music, etc.) is *heard?*
2. *Only* when the letter (word, music, etc.) is *seen?*
3. *Both* when the letter, etc., is *heard* and *seen?*

Note.—Which seems to have been earlier, color with sound or with form?

b. Does the color appear
1. When the letter, etc., is imagined as *heard?*
2. When the letter, etc., is imagined as *seen?*
3. In both cases?

c. Does the color appear invariably or occasionally?

*III. What is the location of the color?

a. Is it in tridimensional space, *e. g.*, in front of you, to the right, etc.? or,

b. Is it as if on a page? or
c. Is it impossible to give the location?

*IV. What is the *shape* or *form*
a. Of color with music and noises?
b. Of color with tastes, etc.?
c. Of color with letters and numerals:—
1. Does each letter and numeral appear as if printed or written in colored ink? or,
2. Has the color some other definite shape? or,
3. Has the color a vague and indefinite shape?
d. Of color with words:—
1. Is each letter colored separately?
2. Are all letters colored, but of one color?
3. Is the word printed or written, in a neutral tint on a colored background?
4. Has the color some other definite shape?
5. Has the color a vague and indefinite shape?

V. (If you have word color)
a. Give your color for
1. Sara.
2. Lottie.
3. Date.
4. Harry.
5. Samuel.
6. Fate.
7. Door.
8. *a.* Meet.
b. Meat.
9. *a.* Carrie.
b. Carry.
10. Alice.
11. Edith.
12. Oscar.
13. Anna.
14. Stephen.
15. Clifford.

b. How does the color of a word seem to you to be determined?
1. Does it follow the color
a. Of the initial letter?
b. Of a repeated letter?
c. Of a vowel or of vowels?
d. Of a consonant or of consonants?
e. Of an accented vowel or consonant?
2. Does each letter have its own color as when perceived alone?
3. Is the color a mixture of the colors of the different letters?
4. Does the color follow the prevailing sounds, so as to be the same for rhymed words?
c. Was word-color earlier than letter-color?

Answer question VI with the fullest details possible.

VI. a. Have you any explanations of your colors, by association, *e. g.*,
1. Of the *letters*, with the colors of blocks or pictures from which they were learned?
2. Of the *numerals*, with some similar objects?
3. Of *names of people*, with the color of hair, or of eyes, or of garments of particular people?
4. Of *names of places*, (*a*) With colors of a map?
(*b*) With varying colors of foliage, etc.?
5. Of names of months with season-colors?
6. Of favorite letters or words with favorite colors?
Note.—Name your favorite colors.
7. Of musical tones with emotions, and so with colors producing the same emotions?
8. Of musical selections with the colors of real or imagined scenes?

b. Mention any other explanations for the origin or for the alteration of your colors.

VII. a. Do your "colored" words aid your memory in spelling?
b. Do your "colored" notes aid your memory for music?
c. Are your colors of any other assistance? (Give full details.)

VIII. Is your pseudo-chromesthesia a source of
a. Pleasure? or
b. Pain? or
c. Neither? or
d. Partly of pleasure, partly of pain?

IX. Have any of your immediate family or other relatives
a. Pseudo-chromesthesia (colored hearing)?
b. Forms?
c. Any similar habit?

*X. Did your pseudo-chromesthesia begin
a. In childhood? or
b. Later? or
c. Part at one time, part at another? (Give details.)

*XI. Has your pseudo-chromesthesia
a. Increased? or
b. Decreased? or
c. Neither? or
d. Part increased and part decreased? (Give details.)

XII. a. Is your pseudo-chromesthesia so strong that
1. If you hear, read, or imagine one of your "colored letters," words, etc., while looking at a white background, the white becomes colored?
2. You have an after-image of the color?
3. A page on which your "colored" words, etc., are printed seems flecked with the color?
4. The "color" of a name actually seems to intensify or to change the color of the dress of the wearer?
b. Mention any other cases in which your pseudo-chromesthesia ever becomes or tends to become hallucination.

XIII. Have you any such peculiar associations
a. With sounds? *e. g.*, do colors suggest musical notes?
b. With tastes, odors, etc.? *e. g.*, do musical notes suggest tastes, odors, etc.?

*XIV. Mention any personal details which bear on the subject, *e. g.*,
a. Are you, in any sense, an artist?
b. Are you, in any sense, a musician?

B. Forms.

I. a. Draw your forms for *series* of words, numerals, etc.
1. For numerals.
2. For months.
3. For days of the week.
4. For years or centuries.
5. For the alphabet.
6. For any other forms.

Indicate the position on each form of numerals, names of months, letters, etc.

b. Draw your symbols, if you have any, *i. e.*, forms for single numerals, letters, etc.
1. For numerals, *e. g.*, 1=△ 2=○ 3=+ 4=ξ
2. For letters.
3. For musical notes.
4. For words.

*II. Please state with reference to each form whether

a. The numerals, names of months, etc., appear as if printed (or written) on the form.
b. The form is colored.
c. Any images of scenes or of objects appear in the forms.

*III. Please state with reference to each form and symbol, whether
a. The form, etc., is flat, like a plane surface.
b. The form, etc., is flat, as if printed on a page.
c. The form, etc., extends in three dimensions.

*IV. Please state with reference to each form and symbol, whether
a. 1. The form, etc., is in front or back of you.
2. The form, etc., is above or below you.
3. The form, etc., is right or left of you.
b. You always imagine yourself in relation to the form, etc.

*V. a. Do the forms appear invariably or occasionally?
b. Do the forms appear as wholes or in sections?

VI. Have you any explanations of the origin or of the particular shape of your
a. 1. Number-form?
2. Month-form?
3. Day-of-week-form?
4. Year or century-form?
5. Alphabet-form?
6. Other forms?
b. Symbols (single forms for numerals, etc.).
Can you refer any forms or symbols to lessons or games of childhood? Are they like any pattern of wall paper or carpet? like a calendar? like a clock face? etc.

VII. a. Does your number-form help you
1. In remembering dates?
2. In any mathematical operation?
3. In any other way?
b. 1. Does your month-form
2. Does your day-of-week-form
3. Does your year or century-form
} help you in remembering dates or appointments?
c. Does your alphabet-form help you
1. In spelling?
2. In looking up words in a lexicon?
3. In any other way?
d. Does any other form help you?
e. Do your symbols help you?

*VIII. Does the possession of the forms and symbols give you
a. Pleasure?
b. Pain?
c. Neither?
d. Partly pleasure and partly pain?

IX. Have any of your immediate family and other relatives
a. Pseudo-chromesthesia (colored-hearing)?
b. Forms or symbols?
c. Any similar mental habit?

*X. Did your forms and symbols begin
a. In childhood?
b. Later?
c. Part in childhood, part later?

*XI. Have your forms and symbols
a. Increased?
b. Decreased?
c. Neither?
d. Part increased and part decreased?

XII. a. Do you ever feel as if the forms and symbols had an actual, external existence?
b. Do they ever involve you in any other sort of hallucination?
*XIII. Mention any personal details which bear on the subject, *e. g.*,
a. Are you an artist?
b. Are you an architect?
c. Are you especially fond of system and method?

C. Personification.

I. Like and dislike
a. For numerals.
1. Do you especially like any numerals?
2. Do you especially dislike any numerals?
Give reasons in both cases.
b. For letters.
1. Do you especially like any letters?
2. Do you especially dislike any letters?
Give reasons in both cases.
c. Mention and explain any similar cases of like and dislike.
II. Dramatization.
a. With numerals.
1. Do numerals seem to you to have physical characteristics? (*e. g.*, is 1 short and fat, 4 tall and thin, 7 brunette?)
2. Do numerals seem to you to have mental and moral characteristics? (*e. g.*, is 8 upright, 14 mean, 16 kind?)
Give reasons for all cases.
3. Is the dramatization so complete that the numerals seem like persons? (Give details.)
b. 1. Do letters seem to you to have physical characteristics?
2. Do letters seem to you to have mental and moral characteristics?
Give reasons for all cases.
3. Is the dramatization so complete that the letters seem like persons? (Give details.)
c. Mention and explain any similar cases of dramatization.
D. Mention any other cases of peculiar association.

PSYCHOLOGICAL LITERATURE.

I. SOME RECENT STUDIES OF PAIN.

1. *Pain, Pleasure and Æsthetics.* MARSHALL. London, 1894.
2. *Beiträge zur Physiologie des Schmerzsinns.* PROF. DR. M. VON FREY, Ber. d. math.-phys. Klasse. d. k. Sächs. Ges. d. Wiss. July and December, 1894.
3. *Die Sensibilität der Conjunctiva und Cornea des menschlichen Auges.* DR. W. A. NAGEL. Pflüger's Archiv, Bd. LIX, 1895, pp. 563-595.
4. *The Origin of Pleasure and Pain.* DR. H. NICHOLS. Phil. Rev., I, pp. 403-432, 518-534.
5. *Schmerz und Temperaturempfindung.* PROF. DR. Z. OPPENHEIMER, Berlin. Georg Reimer, 1893.
6. *Ueber den Schmerz.* PROF. DR. A. GOLDSCHEIDER. Berlin, 1894.

Says Goldscheider, in his recent work, "Ueber den Schmerz," "It is a shame that we possess such insufficient knowledge concerning the character of pain—those symptoms which represent the essential part of all bodily suffering of man." This statement is true if we have in mind our knowledge of the origin and mediation of pain; *i. e.*, whether it is of physiological or of psychical origin; whether it is mediated by specific nerves, or by any or all sensory nerves; whether pain is to be considered as a *quale* of a sensation, a separate, coördinate sensation, or only an intense degree of a sensation;—for on all these points our knowledge of pain is far from satisfactory. On the other hand, if we have in mind the many facts we know concerning pain, its influence on our mental and bodily states, its importance as a guide to health or disease, as well as its value in leading to higher moral and religious action, there is, perhaps, no sensation about which we know more. The difficulty in finding a theory for pain is due, perhaps, in large part, to the great number of isolated facts we already know concerning it. If we knew less we might be willing to accept any one of the many theories already proposed, but as it now is, no theory seems to answer all. The primordial character of pain makes it one of the most difficult of experiences to analyze. It comes to us after untold ages of accumulated experiences, mixed with other, later-developing sensations, from which it is next to impossible to separate it.

Some of the Known Facts.

What are some of the isolated facts that we know concerning pain? To enumerate, without endeavoring to follow any particular order, we may state:

That a stimulation of pressure (touch) is perceived sooner and fades away quicker than a painful stimulus occurring at the same time and in the same place—that is, under normal conditions, pain and touch excitations occurring together are separated in time before reaching consciousness. Again, under the influence of anæsthetics, pain and not touch may be temporarily destroyed, or *vice versa;* for instance, cocaine and chloroform destroy pain and not touch, while saponin destroys touch and not pain. Under clinical and pathological conditions, such as traumatism, syringomyelia, etc., pain may be destroyed without any other sensation being materially injured. Sectioning the gray matter of the spinal cord destroys the perception of pain from parts below the section, without destroying the sense of pressure (touch).[1] In multiple neuritis and certain lesions of the cord, the sense of touch may be destroyed without that of pain. Pain may be produced by an electric spark, or by thermal stimuli, without any sensation of touch.

Again, as shown by Naunyn and others, pain is the result of a summation process. Naunyn[2] found, in cases of tabes dorsalis, that a mechanical stimulus (produced by touching the skin of the foot with a hair, etc.), which is below the conscious threshold of either pain or touch, if repeated a great many times per second (60 to 600), will be perceived, after a few seconds (6 to 20), as a pain which soon becomes unbearable. The same effect of summation can be shown with electric stimulation, where, with a weak current, a few shocks per second are not painful, but a large number per second are decidedly so.

Notwithstanding the above cases, in which it seems possible to separate pressure (touch) and pain, yet normally, especially under mechanical stimulation, pain is seldom found without being preceded or accompanied by touch. It is probably the mixing of these different cutaneous sensations with pain that enables us to locate the latter, and gives to it the peculiar coloring which we designate as acute, sharp, smarting, stinging, boring, lacerating, lancinating, griping, gnawing, aching, bearing-down, etc., according as the painful feeling is mixed more with one or another of the cutaneous sensations. Owing to the insufficiency of language to express such states of consciousness, it is difficult to make the above terms more simple, or even to be sure that the same term is used for the same thing by different individuals. A pain may vary, of course, through any or all of these different qualities at different times.

Pain, according to Erb,[3] is not a sensation of a peculiar form, but one of higher degree; therefore, every sensory stimulus is capable of producing pain, if it reaches sufficient intensity. But we can hardly retain this statement among those of generally accepted facts, for the statement is questioned by those who hold that the higher senses (sight, hearing, etc.), as such, do not give physical pain. On the other hand, every kind of stimulation, mechanical, thermal, electrical and chemical, may excite pain. Any disturbance of nutrition or of circulation may also produce the same result.

Pain is generally accompanied or followed by inflammation of the parts, but what particular relation this bears to pain is not known. Most would agree that, in many cases at least, the pain was due to the inflammation; but Radcliff[4] and some others take the ground

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[1] Schiff, "Lehrbuch der Muskel- und Nerven-Physiologie," S. 251 ff.
[2] Arch. f. experim. Pathol. u. Pharmak. Bd. XXV., S. 272 ff.
[3] Krankheiten der peripherischen cerebro-spinalen Nerven, 1874.
[4] Radcliff, Lectures on Epilepsy, Pain Paralysis, etc., London, 1864. John Churchill.

"that pain of a neuralgic character is antagonized rather than favored by inflammatory excitement of the nervous system." And, further, "where pain seems to be associated with active fever and inflammation, it has been seen that the place of the pain is in the cold stage, before the establishment of the hot stage of the disorder, and not in the hot stage itself—in the stage of irritation preliminary to the inflammation, and not in the stage of actual inflammation." As is well known, pain is a very important sign of disease, and becomes of great value to the physician in his diagnosis, but the pain is very often located at a distance from the seat of the disturbance. For instance, disease of the hip-joint causes pain in the knee; inflammation of the liver, or in the diaphragm, causes pain in the right shoulder; valvular lesion of the heart may produce pain in the left arm; irritation of the stomach may cause pain in the head; stone in the bladder may produce pain in the outlet of the urinary passage; spinal lesions are nearly always referred to some more peripheral part.

Individuals, as well as nations, differ greatly in their sensitiveness to pain. The Irishman is more sensitive than the Scotchman; the Latin race is more sensitive than the Teutonic. There are age, class and sex differences, though the data here are very limited (Lombroso, and later MacDonald[1]). It is also true that the same individual differs considerably from day to day in his sensitiveness to pain without any apparent cause.

Again, a mechanical (pressure) stimulation, which is not at all painful at first, will, if long continued, become not only unpleasant and annoying, but actually painful. Here continuation of pressure seems to change a touch sensation into a painful one. There are some parts of the body, *e. g.*, the cuticle, nails, hair, ligaments, etc., that are never painful; while there are other organs, *e. g.*, the lungs, liver, kidneys, intestines, mucous membrane, tendons, etc., which, under normal conditions, function painlessly, but under pathological conditions become the seat of very severe pain.[2]

To the above may be added the pains due to general depression, fatigue, hysteria, hypnotism, etc. By hypnotic suggestion the body may, on the other hand, be rendered insensitive to pain, while all other sensation remains intact (Witmer[3]).

Still another interesting fact has been brought out by Nagel, namely, that a current of hot air striking the conjunctiva, cornea or mucous membrane of the tongue, is never perceived as warm, but as cold, unless too hot, in which case it feels cold and painful. The other parts of the body, however, perceive the warm current as warm.

Some Recent Theories of Pain.

In order that any theory of pain may be accepted as final, it must explain all the above facts as well as many others not mentioned. There are almost as many pleasure-pain theories as there have been writers upon the subject, and the subject has by no means suffered for want of writers. Each theory may be satisfactory to the man who proposed it, but few can be said to be satisfactory to large numbers, while none seem to be satisfactory to all.

I wish to confine myself in this article to a few of the recent theories of pain, which cover pretty nearly the present status of the subject. These theories may be divided into three groups:

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[1] Am. Journ. Psych., Vol. VI., p. 621.
[2] Oppenheimer, "Schmerz und Temperaturempfindung."
[3] *The Journal of Nervous and Mental Disease*, April, 1894, p. 219, note.

1. Those which represent pain as a *quale* of sensation.
2. Those which class pain as a distinct sensation.
3. Those which class pain simply as a certain degree of sensation.

Under the *quale* theory may be classed nearly all the ancient writers on the subject as well as many of the present day. By far the best exposition of this theory is given by Mr. Marshall in his recent book, "Pleasure, Pain and Æsthetics." This most excellent treatment of the subject has given a new impetus to the *quale* theory as well as to the whole study of emotion. A careful reading of the book makes one feel that there is but little left to be said on that side, and one must admit the great importance of the work, even though he may not be able to bring his mind to harmony with the author's view.

Marshall gives three hypotheses to account for pain and pleasure, of which he accepts the last: (1) "That pleasure-pain modes are the fundamental elements from which all mental life develops, a hypothesis which, apart from other oppositions, is negatived by the fact that our mental life is not developed on two distinct lines, viz., of pleasure and of pain." (2) "That in pleasure-pain we have a special mode of mental activity, a series *sui generis*, unlike and standing apart from any other mental state in character and means of genesis, which, however, is connected with all other mentality in some subtle way." (3) "That pleasure and pain may be differential qualities of all mental states of such nature that one of them must and either of them may, under their proper conditions, belong to any element of consciousness." "Under these hypotheses pleasure and pain are primitive *qualia*, which may appear with any mental element; simple, primitive ideas in the Lockian sense, and, therefore, correctly classed by him; simple primary differentiations of presentation, which are grasped by us essentially after the same manner in which we know the mind to act in other directions, but in the most primal forms of such action." Mr. Marshall says further: "That psychic life is not divided on the lines of pleasure, is no objection to a view which makes pleasure and pain *qualia* of all presentation composing our psychic life as we know it, for the distinctly marked-off psychic states are not supposed to be developments from the pleasure-pain modes, but states still subject to these qualifications.

As to the physical basis of pain, he holds that "no special nerve organs and no distinct differentiations of such organs are to be looked for to account for the *qualia* which relate to the whole field of mental life, for their physical conditions, whatever they be, must be looked for in all that which we learn to look upon as the physical basis; *i. e.*, in all of nerve necessary for mentality whatever special parts are, for any one moment, called into activity. Each case of distinct presentation may thus be said to bring forward its own pleasure or pain organ, as it were, fitted to act under proper conditions." The old Aristotelian idea that "the activity of the organ of any content, if efficient, is pleasurable, if inefficient, is painful," is discussed and changed to the following principle: "All pleasure-pain phenomena are determined by the action in the organs concomitant of the conscious state, as related to the nutritive condition of the organs at the time of the action."

In particular his hypothesis is: (1) that "pleasure is experienced whenever the physical activity, coincident with the psychic state to which the pleasure is attached, involves the use of surplus stored force—the resolution of surplus potential into actual energy, or, in other words, whenever energy involved in the reaction to a stimulus is greater in amount than the energy which the stimulus habit-

ually calls forth;" and (2) that "pain is experienced whenever the physical action which determines the content is so related to the supply of nutriment to its organs that the energy involved in the reaction to the stimulus is less in amount than the energy which the stimulus habitually calls forth." Or, in other words, that "pleasure and pain are primitive qualities of psychic states, which are determined by the relation between activity and capacity in the organs, the activities of which are concomitants of the psychoses involved."

Without quoting farther, we may sum up Mr. Marshall's positions as follows: (1) That pleasure and pain are general qualities, one of which must, either of which may, belong to any fixed element of consciousness. (2) That emotions are the psychic coincidents of relatively-fixed, coördinated, instinctive activities arising upon the appearance of definite objects, and, therefore, only indirectly connected with pleasure and pain. (3) That æsthetics should be treated as a branch of hedonics, or the science of pleasure. (4) That pleasure and pain are determined by the efficiency and inefficiency, respectively, of the organs active in coincidence with the pleasurable or painful mental elements; that efficiency and inefficiency are functions of the relation between activity and nutrition, pleasure being dependent upon the use of surplus stored force, and pain upon conditions under which the outcome of the organ's activity is less than should be expected in consideration of the energy involved in the stimulus.

It seems more proper to designate Mr. Marshall's classification of pain and pleasure as a psycho-physical than a psychological one, and yet his pleasure-pain theory is distinctly psychological, making pain and pleasure due to psychic states as wholes, rather than to the disturbance of any particular organ. Under his treatment, his theory becomes exceedingly flexible, and seems capable of answering nearly all the known facts. He says, in reference to those pains which often seem separate or distinct in themselves, that they do not invalidate his theory, for, under extreme conditions of excess of activity as related to nourishment, the psychosis of relation should be vivid. Pains from organs which are normally not painful, but which become so under hypernormal conditions, are due to the fact that these organs are normally so regular in their rhythm that they are not called upon to act powerfully, and, therefore, have little capacity or use for surplus stored force, consequently any hypernormal condition would cause them to act painfully. The same reason may account for some organs being incapable of pleasurable stimulation.

As to the secondary sensation, occurring in case of a prick, he assumes a second set of nerves, which are brought into action after touch, and respond painfully on account of their little storage capacity. Analgesia, he says, may be answered by one sense being obliterated, while the other is not cut off. But it is difficult to understand how either of these statements can be made to coincide with his theory. In the first statement he has separated the pleasure-pain *quale* from touch, and has made it include the whole of the secondary sensation. In reference to the second statement, if the *quale* may be separated from the sensation, either by different paths of conduction or by disease, there would then be a *quale* without a sensation, or a sensation without a *quale*; either of which would seem fatal to the *quale* theory. It has been shown quite conclusively, however, by Schiff and others, that pain has a different path of conduction in the spinal column from most of the other haptic sensations. To say that under certain conditions the *quale* may

become so intense as to blot out the rest of the sensation, is not satisfactory, for what reason have we to say the rest of the sensation is there, only obscured from consciousness? Furthermore, pain not only occurs frequently unaccompanied by other sensory elements, but may be located at a distance from the seat of the disturbance, and also seems to have a quality of its own. Again, it may be asked, should not the quality of a sensation become more noticeable with practice (exercise), *i. e.*, the quality of wine by experience in tasting—the perfume of flowers by experience in scenting—tints or shades of color of a visual sensation by practice in seeing? Exercise, however, seems to increase instead of decreasing the pain threshold.

According to the *quale* theory, it would not seem possible that the injury of any organ could take place without pain, yet, as is well known, the liver, lungs, kidney and some other internal organs can be cut or in many ways injured without pain, and is it not possible to develop the use of narcotics, to the injury of the whole system, without pain?

Again, as Witmer says,[1] "To assume that every sensation or mental state, whatever, may be presented in the extreme of pleasure, in the extreme of pain, and in any pleasure or pain intensity between these and indifference, would require that quinine, in proper intensity, should give a pleasure equal in intensity to that of the exercise of the sexual function; that the odor of violets, in sufficient intensity, should give a pain as decided and intense as the agony of angina pectoris."

It does not seem to me that this theory can be made to account adequately for the different facts of pain, nor does it seem to me that pain is simply the opposite of pleasure. Real pain often seems as distinct in itself as any other sensation, while pleasure never seems distinct from the sensations or associations which produce it.

Among those who hold the view that pain is a sensation mediated by specific nerves of pain, Prof. M. von Frey of Leipzig has given, perhaps, the best experimental proofs, while Dr. Herbert Nichols of Harvard has presented, I think, the most plausible theory, based on the assumption of specific pain nerves. As these two views seem to represent pretty clearly this side of the subject, I shall give a brief synopsis of both.

Von Frey gives the result of his experiment in two articles, the first published in July and the second in December, 1894.[2] He used as apparatus a great number of light sticks, 10 cm. long, to the end of each of which was attached a hair, forming a right angle with the stick. These hairs varied in length from two to three centimeters, and in size from the downy hairs of a child to the firmest bristles of animals. By a very delicately poised scale, all these hairs were graded, with reference to the force necessary to cause them to bend. A section from the end of each hair was measured under the microscope to get the area over which the pressure was exerted.

With this series of graduated hairs, von Frey could reduce all his measurements to a common unit, which he did in terms of grams per square millimeter; *i. e.*, the number of grams pressure necessary to produce a sensation of touch or of pressure when the contact surface equaled one square millimeter. With this carefully prepared apparatus, he mapped out by a series of pressures the

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[1] *Journal of Nervous and Mental Disease*, April, 1894, p. 213.

[2] "Beiträge zur Physiologie des Schmerzsinnes," Ber. d. math.-phys. Klasse d. königl. Sächs. Ges. d. Wissenschaften. Leipzig, July, 1894; December, 1894.

touch threshold, as well as that for pain, for different parts of the body, giving his results in $\frac{\text{gr.}}{\text{mm.}^2}$. He finds the lowest threshold on the cornea and conjunctiva where he gets pain only. He says: "The hairs exhibit the most sensitive touch apparatus of the body, and the next to the hairs come the hair-bulbs." There are many points in the neighborhood of the hair-bulbs that give only pressure (touch) sensation. Separated from these, and brought out by a greater stimulus, are pain-points. The pain-points are more numerous than touch-points, and are generally found in the places between hair-bulbs. The touch and pain-points are separated by insensitive places. The pain-points, as well as those for touch, vary much in threshold value on different parts of the body. In his first article, he reaches the following conclusions: (1) The punctiform stimulation of the skin, with a gradual, mechanical stimulus, allows the demonstration of two thresholds—a lower one for pressure and a higher for pain sensations. Pressure and pain-points lie locally separate, the former in the neighborhood of the hair-bulbs. (2) There are certain surfaces of the body sensitive to pressure and not to pain, and other surfaces sensitive to pain and not to pressure. The pain-points have, consequently, only a single threshold, which need not lie higher than the pressure threshold of the skin, and may lie even considerably lower, as in the cornea. He concludes, therefore, that the pain sensation is mediated by a special arrangement of pain-points and pain nerves.

The first part of von Frey's second communication is largely supplemental to the first communication. He studies more carefully the relative threshold between neighboring touch and pain-points, and finds the threshold for the latter much higher, except of course on the cornea and conjunctiva, where he thinks there are no touch-points. The relative threshold (pressure threshold, divided by pain threshold) on the arm for mechanical stimulus is given as $\frac{1}{3}$, and on the ends of the fingers as $\frac{1}{80}$ to $\frac{1}{100}$.

The second part of the second communication is the result of a study of these same touch and pain-points by means of electrical stimulation. He finds that touch and pain-points can be located by electrical as well as by mechanical stimulus, the former yielding a whirring, jarring sensation, the latter a pricking sensation. The difference between the threshold of the touch and pain-points is much less when electrical stimulation is used instead of mechanical, or, as von Frey says: "[In electrical stimulation] the threshold of pain-points lies in many places lower than that of pressure-points; the relative threshold is thus greater than 1." There is as much variation in the threshold of different pain-points on different parts of the body as there is between neighboring points of different kinds of sensation.

There is great difference in the inertia of touch and pain-points; the former begin and cease acting quicker on stimulation than the latter. Pain, therefore, accumulates or summates out of proportion to the stimulus, while touch does not. Von Frey has convinced himself that on the extremities 130 shocks per second can be easily distinguished, while 20 shocks per second on a pain-point cannot be distinguished, but are perceived as a continuous sensation. The after-image is, therefore, much more persistent for pain than for touch. The inertia of these points can be shown equally well by mechanical stimulation.

Von Frey concludes by reaffirming his belief in separate pain nerves, with their appropriate end organs. Pleasure nerves he does not assume, but as black is the absence of color, so pleasure is

the cessation or absence of pain.

Dr. Nagel[1] has made a similar study of pressure, pain and temperature points, and from a greater number of cases draws conclusions which are, for the most part, contrary to those obtained by von Frey. Among Nagel's conclusions are the following: The statements of von Frey that the conjunctiva and cornea are capable of painful sensations only, is not correct. The error is explained through the one-sided use of stimulating hairs (which really prick) for the testing of sensibility. By the avoidance of the pricking effects, one obtains pure touch sensations on the conjunctiva. Painless touch sensations are, likewise, easily produced on the cornea under suitable conditions of examination, best through touching the surface with soft, moist and warm objects. Light touches of short duration with the point of a hair are also painless. The physiological proof of pain nerves and of pain-sense organs presented by von Frey, as well for the cornea and conjunctiva as for the body in general, is not made out in a convincing manner.

The finding of spots over the body, where the surface responds painfully to very much weaker stimulus than in other neighboring spots, does not, necessarily, indicate pain nerves and pain end-organs, for, as is well known, the delicate epithelial tissue is covered over with the insensible cuticle. This latter covering consists of scales or cells, which are very much thicker in some places than in others. Where the little furrows caused by the transverse folds of the skin cross each other, we find the most pain-points, as would be expected if these pain-points were due to the absence of protecting cuticle.

Again, the touch-points and the indifferent spots respond painfully if the stimulus is intense enough. This von Frey admits, but says it is due to the disturbing of neighboring pain nerves, which may be true, but the evidence for such an assumption is very meagre. I shall return to this again a little further on.

Dr. Herbert Nichols,[2] on the assumption of specific nerves of pain, proposes a theory for pain on the basis of a supposed biological development.

According to Nichols pain nerves are developed only for the purpose of responding to excessive stimulation, as a warning against violent and injurious influences, and in this they differ from the nerves of other senses, which respond to weaker stimulation and cease acting as soon as the stimulus becomes so intense as to be injurious to the proper functioning of the parts. "The nerves of sight, sound, heat, and so on, would, according to this, respond throughout the range to which they had been differentiated. When the more violent range was reached, which was injurious to them and beyond which they could not perform their function, there the sight would cease, and the nerves of pain would take up the functions to which they had peculiarly developed because of the fact that they could endure them with benefit to the creature from their warnings. Under such an arrangement it would not be necessary that the two ranges, say of sight and of pain, should wholly exclude each other, for it would be well for the warnings to begin before sight was entirely destroyed." Stimuli giving touch and pain, therefore, do not affect the same nerve simultaneously, according to the traditional view, but each sensation is mediated by a separate nerve.

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[1] Wilibald A. Nagel. "Die Sensibilität der Conjunctiva und Cornea." Pflüger's Archiv, 5 Feb., 1895, Bd. LIX.

[2] *Phil. Review*, Vol. I., 1892.

This accounts for the frequent separation of pain and touch in consciousness.

As to pleasure, Nichols is not sure that pleasure should be looked upon as a separate sensation in any such sense as pain, and, therefore, pleasure nerves may not exist. However, the pleasures of sex and the pleasures of eating seem to approach more nearly in their distinctiveness the sensations of pain, and may yet be found to be due to specific nerves of pleasure. According to Nichols, pleasure is the primary sense from which all other senses were developed. As each new sense was differentiated, it assumed part of the primary activity of the pleasure sense, which in turn lost just that amount of its former activity. In this way, as the different senses become differentiated, the pleasure sense becomes less and less distinct, and more given to the centro-neural functions. Those senses earliest differentiated would contain the largest element of pleasure—as nutrition and reproduction. "Though the peripheral fibres of our primary sense system have, therefore, been largely submerged and their functions lost, its central parts, with their functions and their particular mental characteristics, have yet been preserved to us essentially unaltered." In another place Nichols says: "The great bulk of our æsthetic feelings unquestionably are associations and of central origin," which harmonizes with his view of pleasure. "It is the ideas associated with the different sense perceptions, and called up by them, that determine them æsthetically."

Nichols would explain the temperature pains by assuming that the pleasure and pain nerves end in different kinds of tissue, which are so constituted that the heat tissues are actively contracting when the cold tissues are either passive or actively expanding, and that the cold tissues are actively contracting when the heat tissues are passive or expanding. "If, now, we assume, by way of hypothesis, that both pain and pleasure nerves also end in each of these kinds of tissue, and that each kind of such nerves is susceptible to a peculiar intensive range of stimulation, we may form an idea of how our common temperature comforts and discomforts may be explained thereby . . . . It may be easily understood, then, how pain, having developed to warn against too intense temperatures, and pleasure, having developed to prompt to certain conduct best suitable to certain moderate degrees of temperature, that they should thus have grown up sensible only to ranges of temperature mutually exclusive of each other."

Whatever may be said of the plausibility of the theories of pain and pleasure based on the assumption of specific nerves, it still remains doubtful whether such nerves exist. In fact, it would become almost as difficult to explain the reason for such nerves as it is to explain the phenomenon of pain and pleasure without them. For it is difficult to understand how so complex an organism, as pain nerves would indicate, could have developed without continual use, and even if in earlier stages of development such nerves did have use and experience, why has nature not tended to abort them during the long periods of disuse? And yet, one must admit that the nervous mechanism seems always ready to discharge in pains, which may not have been experienced for generations and may not be felt for generations to come. Certainly there would be no economy in nature in thus keeping constantly ready a complex mechanism whose office might well be performed by other already useful nerves. Many persons go through life without ever having experienced a pain in certain of the internal organs; and yet no one doubts that such pains might be called forth at any moment by

the right kind of disturbance. If the assumption of pain nerves is correct, why are many organs, like the intestines, liver, kidneys, etc., sensitive to pain only in pathological conditions? Must we assume different kinds of pain nerves? Pain and pleasure are, without doubt, the first conscious activities of life. If, then, their existence be due to specific nerves, it would hardly seem probable that these nerves, the first to function, should have eluded all investigations. Again, if pain nerves exist, we should expect that the exercising of them would increase their sensibility, while the opposite is true, at least, so far as present experimentation has shown.

A touch with the point of a needle in the palm of the hand will often produce, first, a sensation of touch, and, after a second, another distinct, long-continuing sensation of intense itching; on stronger stimulation, there may be first touch and pain, followed by a long-continuing sensation of itching. Shall we, therefore, assume itching nerves and itching points?

Attention plays such a great part in pain that to locate pain-points in the manner pursued by von Frey would require a great many trials with certainty of the spot and constancy of the pain; for, if stimulation of a point was made on the crest of a wave of attention, it would seem more sensitive than another stimulated at a less opportune time.

The assumption of pain-nerves must mean separate end-apparatus, separate paths of conduction, and most likely a separate pain-centre, or pain cells. The existence of such specific neural apparatus is by no means probable.

In reference to those who hold that pain is simply an intense degree of a sensation, and not necessarily an element of every sensation, there are two theories which I shall mention. The first is contained in the exceedingly interesting one of Prof. Z. Oppenheimer of Heidelberg, entitled "Schmerz und Temperaturempfindung."

Oppenheimer begins his treatment of the subject by presenting some of the different views regarding pain and some of the known facts in regard to anæsthetics, inflammations, etc., and then sets himself "to examine how the effect of the pain-exciting influence is brought about, what parts of the organism are concerned in it, with what nerves these parts are connected, and in what relation to the central system these nerves stand."

1. As to the origin of pain. After examining at some length the cause of pains produced by various stimuli—mechanical, thermal, electrical, chemical, etc.,—Oppenheimer concludes that "everywhere in the organs, even in the sense-organs, the real cause of pain is a disturbance of tissue, in particular a disturbance of chemical sort, whereby either the quantity of the newly-formed products of destruction rises above the normal, or whereby products arise through the influence of a foreign body which are not present in the normal condition." There seems to be only one exception to this law, *i. e.*, that of the induction current. In all other cases the tissue appears as the starting point of pain, and can, if one wishes to hold to the analogy of the sense-organs, be regarded as an end apparatus for the sensations of pain. In harmony with this view, pain may be considered to arise whenever an absolutely or relatively too great stimulation for the excitability of the sensation apparatus occurs.

2. In reference to how the nervous connection between the peripheral tissue and the centre is secured, Oppenheimer is of the opinion that this connection is brought about by means of the vaso-motor nerves, in which he includes only the vaso-constrictors and

not the vaso-dilators. He is led to this view by many physiological, pathological and anatomical observations, among which are:

(a) The different sensibility to pain of different organs and parts of the body. In the cuticle, hair, nails, etc., where there are no nerves, vessels or tissues to be disturbed, there is no pain. The intestines, under splanchnic control, the lungs, with no vaso-motor nerves, etc., are, under normal conditions, insensible, but become very painful under pathological conditions. Also those organs whose connective tissue becomes changed into a more or less firm framework and whose circulation is very defective, are normally insensible to pain, but, under a new vascularization which may develop through an inflammatory process, they become quite painful, as shown in chondritis, osteitis, tendonitis, etc.

(b) The close relation which exists between pain and hyperemia. There is one form of hyperemia arising from sectioning of the vaso-motor path—neuroparalytic—in which there is no pain. This indicates that pain fails after an interruption of the vaso-motor path. In the other form of hyperemia, pain occurs so regularly with the hyperemia that it would seem that the cause of both phenomena is one and the same pathological process. "One might think that the centrifugal vaso-motor nerves and the centripetal sensory fibres are stimulated simultaneously in a nerve trunk or in the centre."

(c) The phenomena of hyperæsthesia and of analgesia seem easiest explained by Oppenheimer on his assumption of vaso-motor conduction and separate paths for pain and touch. He says: "We cannot accept the view that there are nerves whose only object is pain. The assumption of pain nerves appears to me to be as unphysiological as if one should wish to assume nerves of sparkling because he once, by a blow on the eye, saw the phenomenon of sparkling. Pain is, as generally accepted, a real pathological phenomenon, *i. e.*, an expression of a physiological function under unusual conditions." In organs where activity causes but slight change, the *feeling* may be scarcely noticeable—*e. g.*, tendons, ligaments, bones. "Pain is not, as some believe, the highest degree of the sensation of a sense-organ, but the most intensive sensation which results in the vaso-motor nerves under the strongest stimulation."

Oppenheimer sums up his view in the following words, which I have translated rather freely:

1. "What until now has been called the sympathetic, consists of two nerve tracts differing completely in their anatomical arrangement. They are distinguished especially from one another in their relation to the ganglia of the sympathetic and in their manner of central distribution.

"The nerve tract known as the splanchnic arises from the spinal cord, goes in the rami communicantes to the sympathetic, the path of which it follows for a certain distance, then leaves it again in the so-called splanchnic roots, without having entered into connection with the sympathetic ganglia, and continues to the abdominal cavity. From what part of the spinal cord it arises, whether it is connected only with the anterior roots, or whether with these and the posterior, is not known.

"The other nerve tract, which may be designated as the real sympathetic, is described most correctly, as it appears to me, if the ganglion of the sympathetic is considered as its place of origin. Disregarding the fibres connecting with higher and lower ganglia, fibres radiate from it in three directions. To it run fibres out of the anterior root, and from it originate fibres which pass through the posterior root to the posterior horn (after having radiated out in

brush-like form horizontally above and below), whence they are distributed partly to the anterior horn and partly to the crossed antero-lateral column. In reference to these latter, it is not certain whether they ascend without interruption to the oblongata, or whether they reach that only after having connected the single segments of the spinal cord among themselves. With regard to the fibres that go to the anterior horn, the assumption can be made with great probability that they connect themselves with the cells of the anterior and lateral horns, from which arise the nerves which pass through the anterior root to the sympathetic.

"Finally, fibres go out from the sympathetic ganglia to the periphery, where they end in a ganglion cell, which gives off fibres for the vessels and for the tissue.

2. "The anatomical arrangement of the sympathetic is different from all other nerves in that the connection of the sympathetic ganglia with the anterior and posterior roots makes possible a centrifugal as well as centripetal conduction, and the forking in the peripheral end makes possible a second arrangement for centrifugal and centripetal conduction, of which the centrifugal serves for the innervation of the vessels, while the centripetal serves for the stimulation going out from the tissue. The single fibre between the sympathetic ganglion and peripheral ganglion cell mediates both kinds of stimulation. There moves along it in an outward direction a continual current, which arises from the anterior horn and the anterior roots and passes by the vaso-motor nerves to the vessels where it causes the vessel tonus. Now, if a current originating in the peripheral ganglion cell through the stimulation of the tissue, and running in an opposite direction should arise, an obstruction will occur in the flow of the first stream, and, in consequence, a loss of tonus will produce hyperemia in the stimulated tissue. At the same time with the obstruction which the centrifugal stream experiences in the periphery, arises a stimulation of the nerve tract, which goes from the sympathetic ganglia through the posterior root and the posterior horn to the vaso-motor cells of the anterior horn and to the antero-lateral columns. The stimulation of this nerve tract announces itself in two forms . . . .

"In the first place, on account of the spreading of the lateral nerve roots in the spinal cord, and on account of the connection which the single segments of the cord possess among themselves, not only the cells lying next the stimulated fibre above and below, but all vaso-motor centres, are set in excitation, and through this, in spite of the peripheral hyperemia, the usual mean blood pressure remains constant. The cause of this constancy of blood pressure—the chemical or physical change in the tissues—is also, taken generally, the cause of the continual excitation of the vaso-motor cells of the spinal cord and of the continuous current going out from the anterior horn, causing the vessel tonus. During life, the metabolic processes are never at rest, and an interchange of rest and activity in the individual organs is ever present.

"The second form of phenomenon is characterized by the appearance of a feeling. How and where this arises cannot yet be told. The course of the sympathetic fibres in the antero-lateral column, their relation to the oblongata, to the splanchnic and to the brain are not known. It is only certain that we have, during the quiet course of the processes of life, an indefinable common feeling (*Lebensgefühl*); that in the activity of the single organs, this feeling becomes more distinct and reaches consciousness as a sensation of the organ, and that with the strongest stimuli that reach the tissue, pain arises. It is also certain that by stimulation or inter-

ruption of the sympathetic path in the posterior horn, vaso-motor disturbances of different kinds present themselves. In the case of stimulation, hyperæsthesia is observed, and in the case of interruption, analgesia.

"The specific effect of the centripetal path of the sympathetic ganglia on vessel innervation and feeling is shown, not only when in consequence of stimulation of the tissue nerves the centrifugal stream is obstructed, but also when the vaso-dilator nerves are in activity and effect an obstruction of this stream. The neuro-tonic active congestion is connected with violent pain.

3. "For the temperature sense we have no special organ as for the other senses. The temperature sensation is rather composed of two simultaneous excitations, one of which reaches the centre by the tissue nerves and the sympathetic and the other by the specific nerves of touch."

As will be seen, this theory is of a physiological nature, basing the origin of pain on a chemical change of the tissues. The theory is unique in its departure from trodden paths, and seems to answer many of the known facts in a very satisfactory manner, especially the pains of fatigue, hyperemia, etc. Nevertheless, the assumption that the tissues act as end-organs for pain and that the vaso-motor nerves form the path for its conduction, would hardly seem probable.

Among those who have written on the different cutaneous sensations, the name of Dr. Alfred Goldscheider holds the first rank. He has touched on the subject of pain in several of his writings, and in his late work, "Über den Schmerz," he has devoted his attention to pain alone. In a former article (*Du Bois-Reymond's Archiv*, 1885; Supp., p. 87), Goldscheider calls attention to pain-points, which led many to credit him with believing in specific nerves of pain; but, contrary to von Frey, Goldscheider believes that these pain-points are not specific organs of pain. He believes simply that in consequence of especially exposed nerve endings, stretched tissues, etc., less stimulation will produce pain in those regions. Pressure-points always respond painfully when the stimulus is intense, but thermal-points cannot be excited painfully. He says: "The so-called temperature-pain is an association of a real temperature sensation with a painful excitation of the nerves of feeling (*Gefühlsnerven*)." The temperature sensation, as such, may be in the highest degree unpleasant, but never goes over into real pain.

As to the nature of pain, Goldscheider reiterates his former view: "that the sensation of pain is peculiar to the pressure nerves and the nerves of common feeling (*Gemeingefühlsnerven*), but fails in all other sense nerves. Sensations of other sense nerves may be unpleasant, but not really painful." This view is similar to that of Spiess (R. Wagner's *Handwörterbuch der Physiologie*). According to this view, pain is a special quality of the sensation and not a modification of the sensation common to every different quality.

Pains from inflammation are thought by Goldscheider to be due to increasing pressure, and by Oppenheimer to be due to chemical changes and chemical products. As to the origin of pain in general, Goldscheider believes it to be due to a process of summation in the gray substance of the spinal cord. Ch. Richet showed that a series of homogeneous shocks will cause pain, when the shocks singly are too weak to be perceived, and Naunyn found similar results, as already mentioned.

Goldscheider accounts for the phenomenon of summation and secondary sensation by assuming, in harmony with Funke and Wundt (*Phys. Psych.*, 4th ed., Vol. I., pp. 111, 112), "that the sensory

paths are divided in the spinal cord; the excitation runs along the posterior column to the conscious centre, probably only once or twice interrupted by ganglion cells; and, on the other hand, it hits on the way the collaterals of the gray substance, and this not only conducts the excitation, but also brings about a changed excitable condition in the cells. These, after more stimulation, will give forth the stored-up energy, which will likewise be conducted to the sensorium." Two possibilities are here present, "either the pain stimulus is conducted through the gray substance to an especial pain centre, or the path through the gray substance possesses itself the condition which allows the increasing of the excitation until it becomes painful." Goldscheider, like Wundt, holds to the latter view. According to this view, the same peripheral nerves that conduct the heat, cold, or pressure impulses, also conduct the pain impulse, or, perhaps, rather the excessive stimulus which is to produce pain. When these impulses reach the cord, they find separate paths, a primary path through the white fibres of the posterior column and a secondary path through the gray column. Impulses of moderate intensity are conducted along the primary column, but when the impulses are intensive, they overflow through the gray column, where their progress is retarded.

Goldscheider believes, as shown by H. Head (*Brain*, 1893), that pain is due to an increasing sensitiveness in the spinal ganglion cells. Here is where the real change in the stimulus that produces pain takes place. The real source of the pain, then, is in the ganglion cells of the spinal cord. There are two conditions which call forth the increasing excitableness (hyperalgesia) of the sensory spinal cells: the falling out (*Ausfall*) of the spinal paths of conduction, and autochthonic irritability. Goldscheider's position seems to be that all impulses of pressure, for instance, whether excessive or not, are conducted along the same peripheral nerves until they reach the posterior horn, whence, under normal conditions, they pass up the posterior column to the sensorium unchanged, and are perceived as pressure; but, if the impulses are excessive, or the conductivity of the posterior column is weakened, they are conducted by the collaterals to the gray column, where they undergo a transformation, due to the stored-up energy of the ganglion cells, and on account of this change are conducted to the sensorium as pain impulses.

Pain is thus a new element added to other sensations. It seems right to say a new sensation, but as both paths may be conducting the impulses together, it may not be best to look on pain as a separate sensation. According to this view, real pain is due to excessive stimulation of the pressure or common feeling nerves, or to a hypernormal condition of the gray substance of the cord, and, therefore, might better be called an intensive degree of a sensation than a quality.

The different qualities of pain are not due to the pain element itself, but are due to the different sensations with which the pain element is constantly mixed. Pains are of one kind, but are colored by the tones of other sensations. In reference to heat pain, Goldscheider believes it to have no more to do with the temperature sense than the pain which occurs on cauterizing the tongue with sulphuric acid has to do with the acid taste which appears alone with a weakened solution of the acid. It is, however, a pain of the nerves of common feeling through the influence of different temperatures accompanied by maximum sensations and peculiarly colored by them.

"To the cutaneous pains are added the character of sharp locali-

zation; to the pain of muscles is added a diffuse spreading and a feeling of depth, because the overlying skin is perceived as free of pain. The joint pain is frequently connected with a feeling of warmth along with a feeling of stiffness, because the least movement in the joint increases the pain." Along with each pain, therefore, there are other sense contents which give to the pain its peculiar coloring. Goldscheider follows Erb's classification of the different pain qualities, according to which the pains are determined: (a) Through the continual mixing of sense perceptions, as burning, itching, etc., pains. (b) Through the localization and diffusion, as aching, piercing, etc., pains. (c) Through the change of exciting process, as throbbing, etc., pains.

Under the heading of "Pain as a Symptom of Diseases," Goldscheider makes three classes: First, the real pain sensation (*echte Schmerz-Empfindung*). This belongs only to the nerves of common feeling and the pressure nerves, and is brought about by real pain-exciting stimuli (mechanical, chemical, thermal, inflammatory and toxic pains, etc.). In the second class of pains there is present abnormal excitement of the nerves, but not so intense that it should lead to such pain. Sensations, in themselves not painful, by their continuation or their occurrence in unusual places are clothed at first with a feeling of annoyance, and later become painful. This second class is designated as pain of discomfort (*Schmerzweh*),—*dolor spurius*, unreal, indirect, or pseudo-pain. Many of the pains occurring in sickness are of this sort — most headaches, many stomach pains, etc. They are more oppressive and tormenting than the real painful pressure, or tension sensations. In both these classes of pain there is some local suffering of the nervous system, but the mind is not affected. It is entirely otherwise with the third form of pain, which rests on an abnormally increased central excitability, a kind of psychic hyperæsthesia. It is "a 'psychic,' or better, an ideal (*ideeler*) pain." This hyperæsthesia of sensitive mental activity, we find designated in neuro-psychoses as neurasthenia, hysteria, hypochondria, etc. It is developed mostly on the ground of heredity, or from an existing disposition due to long sickness, mental overwork, continuous anxiety, etc., all of which bring about a changed psychic activity. Hypnotic and hallucinatory pains are treated under this head. The physical and psychic pains are not antagonistic. They do not exclude each other, but, on the contrary, may combine with one another. Also a real (physical) pain by frequent repetition, or by long duration, may cause psychic hyperalgesia. The above seems to be an important as well as correct classification of the pains occurring in sickness.

Goldscheider's theory of pain is more attractive to the writer than any of the others presented. It may be necessary to modify his view that temperature points are analgesic in order to explain those tabetic cases where there is hyperalgesia to temperature without hyperalgesia to touch. (Starr: "Familiar Forms of Nervous Disease," pp. 173-175.) It cannot be said to be final, as there are still some facts not answered by it, but it avoids many difficulties. By it, analgesia, whether the result of anæsthesia, hypnotism, or hysteria, is easily explained, for anything destroying the collateral fibres, or lowering the excitability of the gray substance, would destroy pain. It is easy to see how a lesion of the cord might cause anæsthesia or analgesia, depending on the location of the disturbance. Also, how in visceral disturbance, etc., the pain may be referred to peripheral parts of the body, these peripheral parts having their nerve roots in the same segment of the cord as the part of the internal organ disturbed. The secondary sensation, as well as in-

creased and decreased sensibility, can be better explained by conceiving the source of pain in the gray substance of the cord.

As Goldscheider suggested, one may laugh at the idea of the pain of an ingrowing nail being located in the cord, yet the sensory nerve fibre which passes from the toe to the posterior root of the cord, is simply the prolongation of a nerve cell situated in the posterior horn, a structure which acts as a unit. Everybody knows how frequently a disturbance of the stomach may produce pains in the head.

It seems rather unfortunate to be forced to make so much of the nerves of common feeling, nerves which are almost as vague and indefinite as the hypothetical pain nerves. They seem to be the scapegoat for all excitations which can not be accounted for through the nerves already known.

To the writer the distinction between real, direct pain produced by artificial stimulation, local inflammation, neuralgia, etc., and the general pains of discomfort, caused by disturbed nutrition or circulation and general change of nervous functioning, etc., seems to be an important one. The real pains seem a totally disparate sensation. This view would harmonize with the manner of their production in the gray substance as well as agree with their separation in time from touch and other sensations on the way to the sensorium. Real pain cannot be said to belong to the higher senses— sight, hearing, smell, taste,— and cannot properly be treated as the opposite of pleasure. The pains of discomfort, on the other hand, seem to me to be fairly the opposite of pleasure, and properly considered as the feeling-tone of the sensation. They belong to all sensations, and are made up from the complex half-unconscious sensational and ideational elements brought to consciousness along with the sensation.

Both pleasure and the pain of discomfort are general, diffused and complex in their nature, while real pain is definite, generally well localized, and simple. Attention and association, as well as the mental and bodily states, play here an important rôle, and the theories making pleasure and pain in this sense opposite *qualia* of a sensation may not be far wrong.

G. W. A. Luckey.

II. NEUROLOGICAL.

C. F. Hodge, Ph. D.

The Growth of the Brain. A Study of the Nervous System in Relation to Education. Henry Herbert Donaldson. The Contemporary Science Series. Walter Scott, London, 1895, pp. 374, 77 illustrations and 64 tables.

But a single trial is allotted to each to develop a "sound mind in a sound body." A realization that to the attainment of this end some knowledge of the laws governing the growth of by far the most important organ concerned, the brain, might be of service, has been rapidly dawning, and the present book has been awaited by a goodly audience who are interested in the problem of highest development. Physicians, teachers and parents, whose needs, as stated in the preface, the author has in view, certainly form a large proportion of society.

No book in any language attempts to cover the field as this one does. What Exner's "*Entwurf zu einer physiologischen Erklärung*

der psychischen Erscheinungen" does for the individual with regard to certain types of psychic activity, Donaldson would do for the larger problems of individual development, bodily, mental and cerebral, for differences between individuals, on their physical and mental sides, and for the development of differences of sex, race and civilization. Psychic differences between individuals and races seem to be vast. To what in the brain, especially, and in the body, generally, can these be correlated? To what degree is it possible to control, during periods of growth, the development of the physical *basis* in such wise as to raise the individual to a higher level? The book tries to answer these questions, not with vagaries, theories, or superficial platitudes, but with all the well authenticated facts of neurological science up to date.

In beginning with the egg cell and devoting three chapters to the growth of the body and its single organs, the book may remind some of a certain history of New York, which begins with the creation of the world. But in this connection it must be remembered that any discussion of the brain, apart from its relations to the other organs, is misleading in the extreme, and the emphasis which this treatment gives to the point is valuable and timely. Throughout the book, in fact, everything is referred back to the cell as ultimate unit of structure and function. This is in line with the newest physiology (Verworn, 1895), and gives a feeling to start with of beginning with a solid foundation. In these chapters the brain is compared with other organs as to initial size and relative growth, and the fact of interest to theories of education is emphasized, viz.: that of precocious development of the central nervous system. At birth the brain is by far the largest organ in the body. At the ages of seven for girls and nine for boys, it attains practically its full growth. The percentage of brain to body-weight at birth is 12.81, and the more rapid proportional growth of the body lowers this percentage to 2.23 at the age of 25.

The three succeeding chapters (IV to VI) give a most convenient analysis of brain-weight. Each element from specific gravity and water content to the weight of each part for different ages, sexes and races is carefully discussed. Wherever possible, comparisons and statistics are presented in curves and tables, whose meaning can be readily grasped at a glance. All society is laid under tribute so far as available from microcephalic idiots to the most eminent men. It falls out that the latter have, on the average, somewhat larger brains than the average of the pauper and defective classes, from which our statistics are derived. In a list of forty-five eminent men, however, we note that the brains of twelve fall below the average for common men, 1,375 grammes, and four of these even fall into Topinard's class as "small," 1,250-1,001. Between the different classes of society, the well-to-do and the less favored, considerable difference in brain-weight exists in favor of the well-to-do. No statistics exist by which the brain-weight of eminent men can be directly compared with their neighbors of similar social standing. Hence, the author is compelled to leave us in a condition of "healthy skepticism" as to the main question whether brain-weight has any definite relation to intellectual power.

From the side of gross anatomy the author naturally turns to a study of the structural elements, the nerve cells and fibres, discussing in turn their general characters, their development, the architecture of the adult nervous system, and the relations of structural elements to one another. The reader will find here outlined results of the most recent investigations stated in concise form and well illustrated, but the details are too numerous to follow in a review of

reasonable limits. No dogmatism is indulged in, and each view is allowed to stand on its own merits where difference of opinion exists among authorities. With regard to the question of continuity or contiguity of processes, the balance of present evidence is struck in favor of the contiguity theory. To the fissuration of the cortex as an index of intelligence is given no support, and none to the "criminal type."

Chapters XIII to XVII are devoted to treating the functional side of the problem. A fair statement of localization of function is first made; then the general physiology and physiological rhythms of the nervous system are treated, and continuing with a chapter on "Fatigue," the section closes appropriately with a discussion of changes occurring in old age. The topic of sleep is handled in a helpful manner, and the fact of its great importance, not only as to amount, but also as to the length of sleep periods, is discussed. Recent experiments have proved that "continuous loss of sleep is far more rapidly fatal than starvation, and the final changes are very marked, especially in the nervous system." In old age the brain decreases somewhat in size with the general decline of bodily vigor. According to the curves (p. 325) which the author derives from the statistics, this decline in weight is seen to begin for women at about forty-five, for men at fifty-five, and for eminent men as late as sixty-five. This is not so interpreted as to furnish support for any large generalization, since the data for comparison with a similar number of well-to-do though not eminent men are entirely lacking. A short paragraph, giving the author's conclusions from present evidence, is as follows: "The old age of the central system is in a measure independent of the degree to which it is exercised, unless the exercise be so excessive as to cause continual and extreme exhaustion. So far as known, the lumbar enlargement of the sedentary student does not grow old faster than that of the professional runner, and on the other hand there is no evidence to show that the best exercise of the hemispheres does clearly postpone in them the involutionary processes."

This closes what may be termed the practical part of the book, as distinguished from the two brief concluding chapters, which review the chief facts in their theoretical relations. Before going on to these a few points with regard to the preceding chapters may be noticed. Within the brief space of these chapters we have the essence of the best work of nearly 200 specialists. Scattered as it is through the literature of several languages, it has been a labor of years to bring the data together. More than this, methods of different investigators have varied to such an extent that their results, however good, have not been comparable. The author has spared no pains in working all these results over to a uniform comparable statement, expressing all relations of number and quantity in terms of the metric system. Where page after page of tables occur in the original, he has condensed the whole, wherever possible, into the form of curves, whose meaning is obvious. At points where the work of others has proved faulty, especially in matters relating to brain-weights, Donaldson has been enabled, from results of his own researches, to make important corrections. The author is primarily an anatomist and statistician; wherever possible every series of facts is expressed in clearest possible mathematical terms. This will make the book exceedingly valuable to specialists for reference, because in many instances results are stated much more clearly than in the original paper. A further service has been rendered by the author in the way in which he has effected the total separation of the facts each investiga-

tor has contributed from the prejudices and opinions which he may have entertained at the time. Thus far it is a book of facts and details, well authenticated, and entirely free from all personal coloring. Each table, each figure and every authoritative statement is given its exact reference to authors concerned; and complete indexes of both authors and subjects make it easy to ascertain exactly what an author says upon any desired topic. In all these matters of detail, which really determine whether a book is usable or not, the volume leaves nothing to be desired.

The two concluding chapters on "The Education of the Nervous System" and "The Wider View" bring the main facts of neurology into relation: the one to matters of individual education and development, the last to problems of history, race and civilization. The first fact to receive emphasis is that of the precocious growth of the brain. "Long before birth all the cells destined to compose it are already formed," though all have not developed the connections and relations of maturity. And so rapid is its growth after birth and before "formal education" has begun that the author is warranted in concluding that "the act of living is thus the most important natural education process with which the human body has to do." Thus, throughout the argument, the tendency is strong to limit the efficacy of "formal education" and emphasize the importance of natural endowment. "Nurture is of much less importance than nature." It will doubtless appear to many that the anatomical side is given undue prominence in determining the career of a man. For example, in speaking of Venn's observations upon the size of head of Cambridge students, which show that on the average successful men have larger heads than others, the author remarks: "The accomplishments of this fortunate group are therefore to be associated with innate capacities, and have small ethical significance; they may be admirable, just as are the paces of a well-bred colt, but the colt deserves no credit for his gait." It hardly seems that the data furnished actually prove the innateness of these "capacities." May they not have been wholly determined by controllable circumstances, both pre-natal and post-natal? The physiological side, scope for free play of unfolding powers, questions of food, general home nurture, habits, attacks of serious illness, even formal training, form a vast background of causes between birth and the beginning of Venn's observations. Until all these have been thoroughly analyzed by modern scientific child study, it would seem, to say the least, premature to settle down upon the cold-blooded anatomical explanation. If fate by an iron-handed disposition of nerve cells has predetermined the future of an individual, why attempt to do anything? At any rate the anatomical explanation should not be entertained until every possibility of the physiological has been exhausted. It is certainly a far more open hypothesis to suppose that function determines form rather than that anatomical structure is the prime factor. The author's view is not, however, wholly unmitigated. As he expresses it in another place, "while it must fail to produce fundamental changes in nervous organization, education may to some extent strengthen by way of exercise structures already formed, and also awaken into activity dormant cells." This view carried out to its logical consequences and applied to the whole of life would amount to the physiological explanation. Throughout the chapter, however, the anatomical argument receives all the emphasis.

The problem in "The Wider View" is that of education in its most general form. How is the individual to make the best use of his own limited life-cycle while keeping in mind the responsibilities

of the individual to the race? All the data at our command conspire to prove that civilization has had little or no influence upon size, form or structure of the brain. It is true that Europeans have slightly larger brains than savages, but races exist in which the brain is large and still no progress toward civilization has been made. Disappointing as this may appear to civilized conceit, a plausible explanation for the fact lies near at hand. A savage is obliged to meet all the requirements of his life by his own efforts and his own ingenuity. By mutual interdependence and coöperation, civilized society is enabled to accomplish much more, with possibly no greater stress upon the individual. Conditions of life in a civilized community are more favorable to acquisition of knowledge; "but wisdom, as heretofore, continues to linger, and still to occupy its place as the rare performance of a balanced brain."

The best service of the author remains to be noted, viz., that of clearing the rubbish off the field, of drawing sharply the line between fact and hypothesis. Upon nearly every page he is enabled to tell us thus far our knowledge reaches, and no farther. To carry it further we must look to future observation and experiment. This is a great service indeed.

Ueber die sogenaanten Granula der Nervenzellen. FRANZ NISSL. Neurologisches Centralblatt, 1894, pp. 676-85, 781-89, 810-14.

Ueber die Nomenklatur in der Nervenzellenanatomie und ihre nächsten Ziele. FRANZ NISSL. *Ibid.*, 1895, pp. 66-75 and 104-110.

Mittheilung zur Anatomie der Nervenzellen. FRANZ NISSL. Zeitschrift für Psychiatrie, Bd. L, p. 370.

As the result of a long and patient series of investigations upon the minute structure of the nerve cell under various conditions, we have had occasion to thank the author for the perfection, at least, of two important methods for staining the nerve cell. His magenta method for staining cortex, after hardening in alcohol, gave results of great elegance, and is still useful. It has, however, been superceded by his methyl blue staining for all cases where precise granular staining is desired. This method rests primarily on the discovery of Ehrlich that methyl blue has a selective action on nerve tissue. Under Nissl's further direction it has been possible, by the aid of this selective action, to stain portions of the nerve cell protoplasm in a manner characteristic of different types. Thus, his end result is a classification of nerve cells chiefly by the granulation of their protoplasm. More exactly stated—since Nissl would have us do away altogether with the indefinite word, "granule," — substances which have a special affinity for the stain are deposited in a characteristic manner in different parts of the cell protoplasm and in the nucleus. Thus, according to the condition of the staining, whether dense, light or medium, a cell is said to be in a "pyknomorphic," "apyknomorphic," or "parapyknomorphic" condition. Instead of classifying cells by the number or character of their processes, as has been quite generally done, Nissl would classify them by the characters of staining of nucleus and protoplasm. His classification, as far as we have it, may be briefly given as follows: 1. Cytochrome cells, nucleus not larger than that of a leucocyte and cell-body scarcely discernible, found in granular layer of cerebellar cortex and elsewhere. 2. Karyochrome cells, with nucleus larger than that of glia cells, but only traces of cell-body. Typical examples are found in the cells of the substantia gelatinosa of the spinal cord. 3. Somatochrome cells, constituting the great majority of nerve cells, are characterized by a cell-body of definite contour, which completely envelopes the nu-

cleus. According to structure, these fall into four main groups: (a) arkyochrome cells, in which the stained portions take the form of a network; (b) stichochrome cells, stained matter in rather straight stripes or rows; (c) arkyostychochrome cells, in which both network and stripes are present; (d) gryochrome cells, in which the stained material takes the form throughout of small granules. Figures of all but the latter form of cell may be found under the first reference cited.

On Some of the Newer Aspects of the Pathology of Insanity. W. LLOYD ANDRIEZEN. Brain, 1894, Part LXVIII, pp. 549-692.

The idea underlying this paper seems to be the practical laboratory demonstration of the often repeated thesis that for every psychic fact there is a concomitant physical equivalent. In making his demonstrations, the author follows out the physical details much farther than any other writer with whom I am familiar. The aim of the writer being to present a picture in detail of the deviations from normal to be discerned in the brains of the insane, the background upon which he draws must be naturally the normal organization of the nervous system. This presentation of the normal side occupies about two-thirds of the paper. To illustrate the character of the changes found in the insane brain, the author chooses alcoholic insanity as a type with clear causation, ascertainable beginning and duration, and a type of which abundant clinical material may be obtained. The whole discussion is minutely divided under some seventy headings, and possibly a better idea of its general scope could not be given than by naming over a few of the most important topics in the order in which they are treated. First comes a discussion of older views. Then follows a section on comparative neurology, the cortex and cortical lamination, its different classes and systems of cells, its regional differences, its type in the amphibian, reptilian and mammalian brain, functions of the different cells and layers as revealed by their forms and relations of their component cells, and as indicated by stimulation experiments, and by the phenomena of the epilepsies,—Jacksonian and psychical. From these heads we gather evidence which is taken by Andriezen to indicate that the "ambiguous" cells of the second layer and the long pyramids of the third layer are the cells first to receive incoming impressions, hence the primary sensory cells of the cortex, and that the lower layer of polymorphic cells, last to develop and most fully developed in the human brain, are associational in function. Following with "quantitive" and "qualitive" evolution of cortical elements, their "physiological elaboration," "education," "language," and "mental evolution," the author outlines very clearly the "law of psychogenesis." This is the usual conception that as more and more nerve cells (Andriezen uses the term "neuron" in the sense of Schäfer's preferable English equivalent, nerve cell) are developed in the sensory motor arc, psychic activities rise to higher and higher complexity. Even in a frog's spinal cord, this approaches a point where it has proved difficult to say whether the action is purposeful or purely mechanical. The cortex, according to Andriezen, is an enormously complex growth of "neurons" in connection with the olfactory, optic, and fillet radiations. His scheme is, therefore, the one usually adopted in neurology, with the function confidently asserted for a good many structures about which most other authors remain in doubt. For example, Andriezen treats as an established fact the theory that the dendrons are the receiving poles of the cells, and this becomes a point fundamental to his pathological findings, as we shall see

farther on. He also seems to adopt without criticism the idea often expressed by English writers that the fibre-plexuses in the cortex are the chief seat of mental processes, while the nerve cells are merely nutritional foci which keep the fibres in functional condition. From all that we know of the comparative resistance and fatigability of the nerve fibre and the nerve cell, there seems to be little enough ground for any such conception. All our facts point to the neuron as the conductive part of the nerve cell. Whether the dendron has any function of this sort is still a matter of heated controversy among high authorities. It is certainly a legitimate hypothesis to suppose that incoming impulses may be beating upon, say the auditory centres, with equal force during sleep and waking, and that the response which these arouse depends not at all upon the nerve fibre-plexuses, but upon the condition of irritability of the protoplasm in the nerve cells themselves. So, further, the author boldly asserts that no continuity exists between nerve cells, while Golgi and Dogiel both demonstrate such continuity. The importance of these points will become evident as we pass on to Andriezen's scheme of cortical pathogenesis. And they can be determined, not by dogmatic statement, but by decisive preparations, and these which Andriezen brings forward do not fairly clinch with those upon which Golgi founds his view.

Turning to the pathological side, as illustrated by alcoholic insanity, we find, under the "generalized and extensive type of onset," seven distinct elements composing the symptom-complex. Abbreviated from the author's statement, these are as follows: 1. Diminished power of recollection. 2. Diminished power of attention and volition. 3. Diminished initiative. 4. Diminished muscular power, tremor. 5. Blunting of moral sense. 6. Insomnia, nutritive break-down of cortex. 7. Disturbed balance of cortical representations, both as to the external world and the ego, delusions and hallucinations, suspicious, gloomy feelings, etc. Without going farther into detail, it is sufficient to add that for each of these symptoms Andriezen finds an appropriate pathological indication. For difficulty of memory, slowness of reaction, etc., he finds "moniliform swellings" with coalescence of "contact granules" in the dendrons of the first cortical layer. This is accompanied by discontinuity in the staining of neurons. Failure in more distinctively psychic spheres is accounted for by similar changes in deeper layers of the cortex, and these involve the cell bodies of the polymorphic cells, as shown by "various stages of disintegration," and so on *seriatim*. Interesting and suggestive as all these points are, the one thing lacking is a rigid comparison with normal specimens. Andriezen tells us that his conclusions are drawn from a systematic examinatian of "over a hundred" human brains. This gives ground for some degree of confidence in his results. But we are nowhere told, even, how many of these brains are normal and how many alcoholic, and in how many of the alcoholic his findings occur.

Andriezen's treatment of the authors to which he refers is somewhat loose, to say the least. As a single example of this, I may cite my own case. On page 680 he says: "Hodge's work in this respect, following on the older observations of Sadovski and others, shows" —and so on. Sadovski's paper appeared in St. Petersburg under date, April 17, 1889. My own complete paper bears the date, March 15, 1889, and my preliminary paper on the same research appeared in May of 1888. Further, Sadovski's work, in expressed purpose and method, are so thoroughly pathological as to have only a remote bearing on my own. Then who are the "others"? Personally, I care little for priority, but I would be grateful for refer-

ences to papers touching upon physiological changes in nerve cells prior to 1888. Andriezen certainly cannot have in mind either Anfimow or Pauline Ternowski if he has read more than the titles of their papers.

In this connection I feel in duty bound to add a word of criticism with regard to Andriezen's figures. Thirty-six of these are distributed in the text, covering the ground from the nervous system of hydra to the human cortex. Many look strikingly similar to familiar figures in Golgi, Cajal, Lenhossek, Retzius, *et al.* No credit is given, however, and we are led to suppose that they are all drawn from the author's preparations, or from his imagination. Which of these sources has been utilized is the harder to decide, on account of the difficulty or impossibility of ascertaining exactly how the figures were obtained. In no case is even the magnification exactly stated. No reference is made to the use of the camera, and in no case is an adequate history of the particular specimen given. These are matters of great importance, since the chief scientific value of a paper of this kind consists in accuracy and definiteness sufficient to make either its confirmation or disapproval possible.

The first impression on reading the paper is that a contribution of vast importance has been made. Its failure to bear a rigid cross-examination is, therefore, a keen disappointment. Thirty "General Conclusions," covering over five pages, bring the paper to a close, and, though it is full of suggestion, no squid ever more effectually covered his retreat with a cloud of ink.

III. ANTHROPOLOGICAL PSYCHOLOGY.

By Alex. F. Chamberlain, Ph. D.

The Iroquoian Concept of the Soul. J. N. B. Hewitt. Journ. of Amer. Folk-Lore, Vol. VIII (1895), pp. 107-116.

As the author of this essay is himself an Iroquois, it is a distinct contribution to the literature of pneumatology, such as an educated Indian alone can offer. Mr. Hewitt tells us: "Iroquoian psychic philosophy represented the soul as exceedingly subtile and refined, yet material withal, since it could be enclosed in a gourd bottle; as dark and sombre, like a shadow in color; as possessing the form of the body, with a head, teeth, body, arms, legs, feet, etc.; as partially blind by day, but sharp-sighted by night; as immortal by some, but as subject to death and even annihilation by others; as specifically carnivorous, but also eating the things which constitute the ordinary food of the living; as having the ability of uttering sounds, speech, sometimes resembling the whistling or the trilled note of the cricket, and sometimes resembling that plaintive and doleful exclamation so largely used and imitated in the chants of death and of public and private condolence and mourning." As to the state and condition of the soul after death, "there were several well-defined though inconsistent beliefs." The following soul-words are cited and interpreted at length by Mr. Hewitt: 1. *ěrĭ* (soul, heart, mind, as seat of sentiment), whence comes *wa-kat-er-yoñ'-ta-re'*, "I know it," literally, "My heart or soul is present with it;" (2) *Ka'-ni-kon'-rä'* (soul, mind, intellect), a derivative from the verb-stem *-'ni-kon-ton*, "to think," which itself seems to be a reflexive form of the verb *-kon*, "to see," with "the pluralitative suffix *ton*, denotive of the multiplicity of the act or thing affected by it;" (3) *oñ-non'-kwä't*, which now signifies "medicine," but is in archaic use

for "soul," — its literal meaning, however, is "begging, craving, desiring;" (4) *ug-skĕñ'-nĕ* (soul, spectre, phantom, ghost, death), strictly applied to the sensitive soul and not to the intelligent or reasonable soul; the literal meaning of the word is "bone,"—the primitive Iroquois regarding the "bones" as the soul's abode; (5) *oiä'ron'*, a crystallization of the idea of metempsychosis, for this word, which is also applied to the fetish or symbol of the tutelary spirit of soul of a person, is a derivative which really signifies, "what is typified, copied, imitated in form," etc.; from *oiä'-ron* comes the general Iroquois word for "flesh," *oieroñ'tă'* ("the substance of the soul").

Sexual Taboo. A Study in the Relations of the Sexes. By A. E. CRAWLEY. Journ. Anthrop. Inst. (London), Vol. XXIV (1894-5), pp. 116-125, 219-235, 430-445.

The author has collected from the accounts of travelers an immense store of information, of value especially to the psychologist, on the taboos and prohibitions of sex. The social etiquette, political status, family-life, occupations, religious rites and customs, language, table-manners, etc., of men and women of primitive races in all parts of the world are passed under review, and it is to be hoped that the author, who styles his essay "a preliminary sketch," will soon give his studies some substantial and lasting form. The following sentences are worth quoting here: "The social relations of the sexes have rarely followed the lines marked out by natural laws. At an early stage of culture man seems to have exerted his physical advantages, and to have thus readjusted the balance in his own way. The subjection of the female sex is a general law of history. The inferior position of women does not, however, necessarily involve ill-treatment; which is rare, or unfair division of labor, which has perhaps in many cases been mistakenly ascribed. The main result with which I am concerned is the attitude of superiority assumed by man, and his contempt for woman as a physical and social inferior. The latter opinion of the female sex is the result of subjection, while the feeling that woman is the 'weaker vessel' is universal and may exist independently."

Shamanism in Siberia and European Russia, being the second part of "Shamanstvo." By PROF. V. M. MIKHAILOVSKII, of Moscow. Translated by Oliver Wardrop. Ibid., pp. 62-100, 126-158.

A detailed account of shamanism and shamans among the primitive peoples of European Russia and Siberia, replete with items of psychologic import and value. The training of the priests, the trances, exorcism, and the paraphernalia of the "medicine man" are all treated of, beside legends and folk-lore belonging to the subject. Interesting is the following passage: "Shamanism among the Siberian peoples is at the present time in a moribund condition; it must die out with those beliefs among which alone such phenomena can arise and flourish. Buddhism on the one hand, and Mohammedanism on the other, not to mention Christianity, are rapidly destroying the old ideas of the tribes among whom the shamans performed. Especially has the more ancient Black Faith suffered from the Yellow Faith preached by the lamas. But the shamans, with their dark, mysterious rites, have made a good struggle for life, and are still frequently found among the native Christians and Mohammedans. The mullahs and lamas have even been obliged to become shamans to a great extent. Many Siberian tribes who are nominally Christians believe in the shamans, and have recourse to them."

The Kalou-Vu (Ancestor-gods) of the Fijians. By BASIL H. THOMSON. Ibid., pp. 340-359.

The most interesting portions of this article are those treating of the "journey of the soul" to the dwelling-place of the gods, the mountain of Nakauvadta, the theme of a great drama by a forgotten native poet, and the "new religion," which arose in 1885. This latter, with its "prophet" and its turning of the Bible and the missionary teachings to native account, finds parallels among the Cherokees and other primitive peoples, with whom some clever shaman has seized the resemblance between Bible-story and native-legend to prop up his own power, or to introduce a "new religion." The interest to the psychologist lies in the "ingenious compound of Christianity and heathenism" which these "prophets" put forth. In Fiji, Jehovah and Jesus were identified by Dugumoi, the apostle of the "new religion," as Nacirikaumoli and Nakausabaria, "who, after their defeat by Degei (Satan, the serpent), sailed away to the land of the white men, who wrote a book about them, which is the Bible; only they lied about their names, falsely calling them Jehovah and Jesus." The resurrection and the millennium were prophesied as near at hand, temples were instituted, and the "outbreak of heathenism" was stamped out by the deportation of Dugumoi and the leveling of the site of an entire village.

The Interpretation of Folk-Lore. J. W. POWELL. Journ. Amer. Folk-Lore, Vol. VIII (1895), pp. 97-105.

In this address Major Powell explains in characteristically terse and expressive fashion the various stages into which he classifies the attempts of mankind to interpret man and nature,—*imputation*, *personification*, *reification*, *science*.

The Folk-Foods of the Rio Grande Valley and of Northern Mexico. JOHN G. BOURKE. Journ. Amer. Folk-Lore, Vol. VIII (1895), pp. 41-71.

This detailed study by a competent authority of "folk-foods," contains not a little of interest to the psychologist. It is noteworthy that both the Jesuits and their predecessors in New Spain, the Franciscans, "gave earnest attention to the study of native foods, and improved upon the cooking of the natives." To the natives of America we owe chocolate, the tomato, and the pine-apple—all of which were known to the Aztecs. "So pronounced," says the author, "is the natural aptitude of the Mexicans in the culinary art that I think it would be a wise policy for the general or state government of that country to institute cooking schools and instruct classes in the chemistry and preservation of foods, with a view to aiding in the future establishment of factories for the canning of fruits, meats and vegetables, or the making of the delicious 'cajetes,' 'almibares,' and 'jaleatines,' which will be referred to in other pages of this paper." In the streets of the town of Morelia the "dulceros" offer to the public no fewer than thirty kinds of candies, and candied fruits are legion. Cakes and other toothsome confections are quite as numerous. The vogue of these to-day is attributed by some to the Carmelite nuns of olden days, who helped along nobly the "sweet tooth" of the native women. Capt. Bourke tells us that "there are very few towns which do not maintain public flower gardens in the main plazas," and other evidences of æsthetic tastes are not absent.

L'Infantilisme, le Féminisme et les Hermaphrodites Antiques. Par HENRY MEIGE. L'Anthropologie (Paris), Tome VI (1895), pp. 257-275, 414-432.

The writer of these interesting articles points out the recentness of the terms *Infantilism* and *Feminism*, the corresponding French words "finding no place in the Dictionary of the Academy in Littré, or in any of the medical encyclopedias, though the terms introduced by Lorrain have been in use for more than thirty years. Following M. Féré, the author classifies the sex-anomalies thus: *masculinism* (where the secondary sexual characters of the male predominate); *feminism* (where the secondary sexual characters of the female predominate); *androgynism* (mingling of the secondary sexual characters of male and female); *infantilism* (preservation of the corporeal forms of infancy). The articles are illustrated, and the author gives details of cases and bibliographical references. M. Féré calls attention also to the marked corporeal and psychical rapprochement of the woman and the child.

The Origins of Invention. A Study of Industry among Primitive Peoples. (Contemporary Science Series, No. xxviii.) By OTIS T. MASON, Curator of the Department of Ethnology in the United States National Museum. London, 1895, 419 pp.

The special facilities of the United States National Museum and the author's marked ethnographic skill have enabled Prof. Mason to write an interesting and instructive book of the beginnings of human industry. Under the following chapters: Tools and Mechanical Devices, Invention and Use of Fire, Stone Working, The Potter's Art, Primitive Uses of Plants, The Textile Industry, War on the Animal Kingdom, Capture and Domestication of Animals, Travel and Transportation, The Art of War, the author presents a vast amount of detail useful for the psychology of human action (mental and physical) and the propagation and dissemination of the knowledge *to do*. We have pointed out to us the fore-runners of our modern triumphs of inventive skill, and it is astonishing how many inventions the savage and barbarous races possess. To use the words of the author: "The devices of pristine man are the forms out of which all subsequent expedients arise. The fire-sticks of savages are the earliest form of illumination by friction. The tribulum is the modern thresher with stone teeth. The kaiak furnishes the lines of the swiftest racing boats. The sewing machine makes no new loops. Warfare is still cutting, bruising, or piercing. All art lines and geometry were born in savagery. Society, even, can never change in organizations and motives. Our most precious maxims ante-date literature. The whole earth is full of monuments to nameless inventors." Prof. Mason's book is one that should be welcome to every psychologist and historian of the human mind in its relation to the earth and all that therein is.

The Character and Antiquity of Peruvian Civilization. By GEORGE A. DORSEY. (Reprinted by permission from Denison Quarterly, Vol. III. No. 1, Granville, Ohio), 10 pp. 8vo.

Dr. Dorsey, who has had an opportunity of reasoning *de visu*, since he has been himself in the land of the Incas, takes a very high view of ancient Peruvian civilization, and a very low one of the influence of the Spaniards upon native culture. The condition of the Quichuas "has not improved in a single particular," while alcohol, Spanish oppression, corruption in religion, and the con-

stant reminder of their "inferiority" to the conquerors, have aided in their degeneration. The religion of the most enlightened Peruvians of old was almost monotheistic; they had national songs, love songs, dramas, the best elements of a national literature; as architects and agriculturalists, they surpassed more than one country in contemporary Europe, and in government and social order, their confederation was nobler than those of the Greeks. How far they might have proceeded in culture, had not the irruption of Europeans taken place, we know not; but, as Dr. Dorsey points out, the limited amount of arable land, and the absence of the horse, goat, cow, camel (they had the llama only), forbade their reaching the very highest stages.

The Protohistoric Ethnography of Western Asia. By D. G. BRINTON. (Reprinted May 23, 1895, from Proc. Amer. Philos. Soc., Vol. XXXIV.) Phila., 1895, 32 pp. 8vo.

The conclusions reached by Dr. Brinton in this brief and admirable *résumé* of the results of recent studies of the ancient peoples and languages of Western Asia, are: (1) No evidence of a prehistoric non-Eurafrican race in Western Asia, whose soil has always been held by the Caucasic, Semitic, or Aryan branches of the white race; (2) the area of the Caucasic stock in prehistoric times was more extensive to the south, whence they have been driven by Aryans and Semites; (3) the limits of durable ethnic impressions by the Semites have been from time immemorial the mountains of Amanus on the west, the Masius on the north, and the Zagros on the east; (4) from the Zagros to the Pamir the Aryans (with whom are classed the Medes and proto-Medes) were in possession at the dawn of history; (5) the civilization of Babylonia arose from some branch or blend of the white race, and not from any tribe of the Asian or Yellow Race, still less from the Dravidian or Black Races; (6) the Anatolian group of Asia Minor was allied to the Gallo-Celtic tribes of central Europe, and preceded by probably several millenniums the Hellenic migrations into Asia. Dr. Brinton makes clear the ethnic phenomena of Western Asia, over which imaginative writers have spun so many cob-webs.

Crania from the Necropolis of Ancon, Peru. By GEORGE A. DORSEY. (From the Proc. Am. Ass. Adv. Sci., Vol. XLIII, 1894), 12 pp. 8vo.

Dr. Dorsey gives measurements and tabulations of 123 crania—58 males (natural), 32 males (deformed), 28 females (natural), 23 females (deformed), 14 children. A curious fact brought out is that the average capacity of the deformed males (1,480cc.) is greater than that of the natural males (1,450cc.), while that of the deformed females (1,185cc.) is much less than that of the natural females (1,270cc.).

The Algonquian terms Patawomeke and Massawomeke. W. W. TOOKER. Amer. Anthrop., Vol. VII (1894), pp. 174-185; *On the Meaning of the Term Anacostia*, ibid., 389-393; *The Name Chickahominy*, ibid., Vol. VIII (1894), pp. 257-263.

Mr. Tooker's keen analysis of Algonquian place and folk-names is one of the best contributions of recent years to the science of linguistic psychology. Upon him the mantle of Dr. J. H. Trumbull seems to have fallen. America hardly needs the appeal of De la Grasserie to see the importance to psychology of the study of primitive languages.

What Indians Mean to do When they Sing, and how Far they Succeed. JOHN COMFORT FILLMORE. Journ. Amer. Folk-Lore, Vol. VIII (1895), pp. 138-142.

Prof. Fillmore's thesis is as follows: "I am profoundly convinced that the unity of all music, primitive and civilized, will become the most striking fact which will force itself on the attention of the observer; that it will certainly be found that the Indian always intends to sing precisely the same harmonic intervals which are the staple of our own music, and that all aberrations from harmonic pitch are mere accidents, due for the most part to imperfect training, or rather to the total lack of it." The details of the demonstration of this theory, which seems supported by the experience and experiments of Prof. Fillmore, Miss Alice Fletcher, and Dr. Boas, are given in author's interesting pages.

IV. PSYCHIC RESEARCH.

Apparitions, Thought-Transference and an Examination of the Evidence for Telepathy. By G. FRANK PODMORE, M. A. London, 1895, pp. 401.

Ueber Trugwahrnehmung. Von EDMUND PARISH. München, 1894, pp. 236.

Ueber den Wahn. Von DR. M. FRIEDMANN. Wiesbaden, 1894, pp. 196.

Proceedings of the Society for Psychical Research, ending with and including part XXVIII. July, 1895.

Sphinx. Bd. XXI, 1895. Braunschweig.

The Psychical Review, quarterly, since 1893. Grafton, Mass.

Rivista di Studi Psichici. Anno I, 1895. Milano, Padova.

An American psychologist concludes a series of reviews of recent border-line literature in the January number of the *Psychological Review* with these words: "The telepathic theory, and whatever other occult theories may offer themselves, have fairly conquered the right to a patient and respectful hearing before the scientific bar; and no one with any real conception of what the word 'science' means can fail to realize the profound issues which such a fact as this may involve." He also thinks that "the Sidgwick report affords *a most formidable presumption* that veridical hallucinations are due to something more than chance." A few pages before he speaks of telepathy as a name given "in lieu of a theory about it," which looks as if the issues were not so profound after all. Mr. Podmore, in his "Apparitions and Thought Transference," says "the treatment of telepathy by those responsible for the word involves just as little theory as Newton's conception of gravity." His state of mind seems summarized in the sentence, "There is hardly any longer room for doubt that we have something here which no physical process at present known can adequately account for." This transference, "without word, gesture or conscious thought," and also by channels other than those of the senses, may be in the normal or may be in the hypnotic state. It may appear in the percipient as a vague distress, a blind impulse to act, sleep, hysteria, local anæsthesia, mental imagery of various kinds, ideas, neuroses, and may be the action of mind on mind, or perhaps of brain on brain, etc. "There are indeed indications that contact facilitates the transference." "It is, of course, to be anticipated that the difficulty of affecting telepathic connection would increase very rapidly with the distance." Mr. Podmore also candidly adds that "in our experiments an increased interval between

agent and percipient, especially if a wall or floor is made to intervene, has affected the results prejudicially." "In the experiments conducted in the same room or house, and in most of the spontaneous cases at close quarters, the idea transferred corresponds to a mental image consciously present in the mind of the agent." On the other hand, "in most cases of thought transference at a distance, the idea transferred is not one consciously present in the agent's mind at all—the idea of his own personality." The telepathic junction between two minds may be effected "through the absolute," as Malebranche thought pre-established harmony was, or by means of radiant "neuricity." Mr. Podmore concludes that he is "entitled to suggest that some kind of vibrations, propagated somehow through a conjectural medium, from an unspecified nerve-centre, may possibly explain the transference of thought." That something from something through something, somehow may possibly account for it, is certainly modest, but to our own thinking, does not suggest a very high standard of what scientific explanation really is.

Although "the absence of mundane analogies and the difficulties attending any such explanation yet suggested, forbid us to assume that the facts are capable of expression in physical terms," yet it may be that we have here "traces of the primeval unspecialized sensitiveness which preceded the development of a nervous system —a heritage shared with the amœba and the sea anemone." "There are surely phenomena here which seem to point to super-normal faculties, such as clairvoyance, retro-cognition and prevision, themselves hardly susceptible of physical explanation." In view of all this, it is not surprising that "the future place of telepathy in the history of the race concerns us even more nearly than the mode of its operation," and he proceeds to inquire whether this marvelous new-found "faculty, as we know it, is but the germ of a more splendid capacity, or the last vestige of a power grown stunted through disuse." His conclusion is that while very likely telepathy will amount to a good deal in the far future, it probably played a great rôle in the past, and "is, perchance, the relic of a once serviceable faculty which eked out the primitive faculty of gesture, and helped to bind our ancestors of the tree or the cave in as yet inarticulate community." While "the first stage of our inquiry is not yet complete," and it would be "futile to declare" concerning the new agency, still "if there are sufficient grounds for believing in faculties which give to man knowledge not derivable from living minds, of the distant, the far past and the future, it would be more reasonable to regard telepathy as a member of the group of such super-normal faculties, operating in ways wholly apart from the familiar sense activities, and not amenable, like these, to terrestrial laws."

On the other hand there are things that the psychic researchers have the virtue to doubt. In his article on "Resolute Credulity," Mr. Myers sets forth seven theses with eleven sub-heads, as not yet having received evidence enough to give them even a *prima facie* claim to be regarded as true. These, roughly put, are eastern magic, the Blavatsky performances, influence of the stars, palmistry, the miraculous effect of the water at Lourdes, certain claims of Christain science, save so far as suggestion may account for them, and the production of supernatural or telepathic phenomena, such as are pretended to by some showmen. Mr. Myers explains that there are now two groups ef psychologists: first, the accurate experimenters, who work on the senses, fatigue, reaction times, attention, memory, mental imagery, the nervous system in general,

and a host of cognate inquiries. But "the drawback is that such methods and such apparatus are better adapted to give accuracy to facts already roughly known than to carry the inquiries much farther into the depths of our being. It is work preparatory to discovery rather than discovery itself." "At the other end of the range, a group still small, though it spreads yearly, somewhat wider in each civilized land, is attacking psychological problems of the highest importance, but which admit as yet of only approximate and tentative methods of inquiry. This is work of discovery indeed; but it is rough pioneer's work — preparatory also in its own way to the ultimate science to which we all aspire." "If you choose the former task as your own, you can progress without mistakes; if the second, you needs must make many mistakes, since no man who dares not be often baffled can reach the secret of the snows."

To "colligate" the views falteringly shadowed forth above, the agent may, perhaps, act on the percipient by means of a purposive idea if he is near, or a more unconscious "personality suggestion" if far, by an impulse which may be somehow associated with a physical agent, like neuricity or vibrations, or may act independently of these through some medium, or directly mind on mind, or brain on brain, or indirectly through the absolute. The percipient receives the impression either as a mental image, an impulse to act, a vague unrest, or a neurosis. The super-normal faculty in this action played, mayhap, a great rôle in the past, before speech, in binding primitive man into social communities, or, perchance, it is a rudimentary organ of a primitive diffused sensitiveness, which preceded the special senses and even the nervous system. On the other hand, possibly, it is a just nascent faculty whose golden age is yet to come. At all events, in the present time, it is either a vestige or a bud, and we must throughout beware of "mundane analogies," and remember that it is, perhaps, "not amenable to terrestrial laws," nor susceptible of "physical expression."

It would seem that the "time had now come for American psychologists to ask themselves squarely, not in the spirit of "scoffers," but as most urgently needing for legitimate use in research every tentative theory that is scientifically legitimated, whether the above general conclusions of this matter, that "the telepathic theory and whatever other occult theories may offer themselves have fairly conquered the right to a patient and respectful hearing before the scientific bar," and whether there is now "a most formidable presumption" in this field, are right; or whether, on the other hand, as we are profoundly convinced, the entire telepathic presumption is yet very far from being a *prima facie* case, is premature at best, and that it is at present with its rank mazes of mystic guess-work a source of befuddlement and obfuscation galore. To say that telepathy "is a name given in lieu of a theory about it," or, with Mr. Podmore, to say it "involves just as little theory as Newton's conception of gravity," seems to us almost grossly misleading, to say the least. Telepathy began as a definition of a new mode of psychic interconnection, and, instead of resting on the commonest facts of sense, and proving by mathematics, it has yet to find a single fact that can be demonstrated regularly in laboratory courses that proves or even illustrates it with certainty.

First of all, it is the vice of the researchers that they have vicious methods of treating the great body of non-experimental material. The value of the spontaneous cases is exceedingly great, not because they bear on telepathy, but as human documents. Indeed, some of them probably would never have been recorded had not the

society raised the question whether hallucinations were not sometimes veridical. The writer is at present working over 1,700 returns to a *questionnaire*, in which there are, perhaps, two score accounts of dreams of flying, hovering, or floating. These, a dream interpreter might say, strengthened the case for levitation, or, perchance, suggested a vestigial heritage of the time when man's far-off progenitors were aquatic, or would soar through space in the future, or that the soul left the body, and did hover, etc. If our dream philosopher were logically disposed, he would, perhaps, tell us that if we diligently collected cases, we might even reach a degree of probability for something residual about such dreams, as great as Mr. Gurney said existed for thought transference, viz.: "the ninth power of a trillion to one." Now, every logician and every mathematician knows that we have no good theory of absolute chance, and that there is a sense in which the probabilities against any given act or event are infinite, and that the sworn testimony of the four best men in the world, that they really saw the four straight suits of well-shuffled cards dealt one to each man, on an outgoing train from Boston a few years ago, could never begin to offset the vast probabilities against such an event. But our point is that the interpreter's method in treating dreams is not the scientific one, or at least can become so only after a vast collection has been made of all kinds of dreams, and by a method which does not appeal at the outset to the wide popular prejudices that there is something true about dreams. We want thousands of dreams recorded at once by the Nelson or some better method, with all possible detail and circumstances, and then we will study their veridical along with other implications, which is a very different method, and will lead to very different, results than if we had collected dreams of flying or floating to study their bearings on some revolutionary theory of levitation. The dream interpreter might, perhaps, claim great credit as being the first to study dreams, but it is only as the old *natur-philosophie* which held instinct to be divine and prophetic, might claim to have first studied it, when all their work was really only in the anecdote stage. The difference between the methods of the researchers and those of men like Friedmann, or to go farther back, Kandinsky, is immense. The latter wish to know all about the cause, frequency, mental and cerebral conditions and details of all kinds of hallucinations. The former laoded the dice at the start in favor of those that bear on a simply stated but stupendous theory and tremendously reinforced by all the old prejudices that make men lynx-eyed for every faint trace of evidence for the independent existence of the soul apart from the body, and bat-eyed for all against it. It is the difference between Kant and true idealism and Swedenborg and pneumatology. The dreams of a metaphysician are surely not likely to give the true explanation of the dreams of visionaries.

The value of the so-called experimental investigations of the researchers we regard as of far less value than the record of spontaneous cases. The latter will remain a valuable collection of data; the former will, we think, ere long all be looked upon by psychologists as the elaborate tests with the Creery girls have been since their confessions. The writer has visited seers and seances for years and has devised many tests, especially three, which, had they been successful, would very likely have compelled belief in his mind. These involve the strongest possible reproduction in the mind of a past fact of feeling, will and intellection, each one of greatest strength and importance in his case and each also written large on one page, but sealed, the seer to have the package and the writer, at the same

time to intently think its contents. This would, of course, succeed with many subjects, but with the writer it is uniformly declined, or totally failed of. Till there is at least some single case in which with effective apparatus and fixed conditions, telepathy, genuine in quality, but ever so faint in quantity, can be demonstrated as surely as argon can be made, or oxygen frozen, or, at least, as the powers of a lightning calculator, or the hypnotic exaltation of a sense, it must rank with the Keely motor, those who assist at the demonstration of which leave in a deeper limbo of uncertainty than when they went, while only a diminishing few find a *prima facie* case strong enough to prompt the investment of money, unless, indeed, they are already so deeply committed to it that they desperately add more and more in the forlorn hope of saving former investments — a case which we are persuaded has its analogue with some of the researchers. A member of the society who prints communications in the English proceedings, and a person of liberal education, called on the writer a few years since to be shown a special form of the slate-writing trick. This was first done with due talk of spirits, raps, etc., then it was explained and demonstrated. The visitor finally sat back in his chair and said in substance that he must believe that I did it by the aid of spirits rather than as I had explained, for it seemed so much more simple and natural. I could not convince him that I was not a medium, and very probably he thought a most disreputable one, denying the real agency that did my work for the sake of pretending to be scientific. The writer has diligently read the experiments of the proceedings, and can honestly say that there is not one in which the conditions as reported seem to him satisfactory. A physicist may erect effective precautions against one whole group of possible sources of deception; the neurologist against another; the psychologist against another, and so on through a long list; but there will yet remain a vast residual possibility of new codes, conscious and even unconscious, of devices that seem most impressive till known, and then disgustingly simple and even vulgar. The most honest men in the world are often least aware, and that from the very honesty of their nature, of the infinite intricacy of their automatic natures and the tricks it can play. Give us one little fact, ever so little, that we can freely test and reproduce one a year in our laboratory. We will cross seas to see it, will acknowledge our mistaken skepticism, and confess telepathy, and turn the research of one laboratory at least in a new direction.

The following are some of the conclusions reached in recent numbers of the "Proceedings": Applying the new psychological methods to the discussions of the voices heard by Jeanne d'Arc, Mr. Andrew Lang concludes that some persons "entirely sane may be so constituted as to see and hear, as if externally, their ideas and mental impressions," and is also "compelled to believe in some abnormal extension of faculty, corresponding to her nature and unparalleled genius. To a certain extent she was admitted within the arena and sanctuary of the universe." Dr. Ermcova, as a result of experiments with a woman with remarkable automatic powers, especially shown in writing in the waking state, which are described in about seventy pages, sums it all up by thinking that the beginning of an explanation of telepathy, based solely on experience, may be given by admitting the existence of telepathic agents of a nature unknown to us, but certainly different from the personalities treated of in ordinary psychology. These agents, in consequence of a voluntary or involuntary excitation coming from the sensorial agent, transmit to a distance, by pro-

cesses unknown to themselves, the ideas they were charged to convey, or which, of their own initiative, they judge it opportune to convey. The "Elvira" which controls his sensitives he thinks on the whole we may call a personality, and says, "If I had not been previously in rapport with Elvira and asked her aid, it is probable that I should never have had an opportunity of observing a single telepathic dream." Mr. Myers fills nearly 200 pages with the experiences of W. Staunton Moses, "one of the most noteworthy lives of our generation," with whom thirty-eight principal spirits are claimed as communicating, including those of Beethoven, Swedenborg, President Garfield, Louis Napoleon, etc. Mr. Moses, who died in 1892 at the age of fifty-three, was an English clergyman, unmarried, of high character and intelligence, whose phenomena are presented in tabular form, and include movements of objects untouched, levitation, passage of matter through matter, intelligent raps, lights, objects materialized, etc. Mr. Myers cautiously concludes that it remains at bottom a mystery,—that we do not know the laws that govern the distribution of his strange and perplexing gift. "Yet, if indeed through such glimpses, such messages as came to my friend, our race is being obscurely guided into an avenue of eternal hope, it matters little whether we talk of chance or of merit."

Outside England occultism, in the smart new garb of modern science, is abundantly represented. In Germany, current numbers of *Sphinx* discuss the "Determination of Sex at Re-incorporation," magic and theosophy, astrology, speaking mediumship, extra-corporeal existence, the astral body, etc. In Italy the new *Revista* describes apparition at the time of death, translates and digests the English work, and in the opening number last January protests in a long editorial against "misoneism," especially that form of it based on a desire to avoid painful effort and the tedious re-adaptation of the mind to new conditions, which is charged against those who cannot accept the new teluric psychism. The Italian Psychic Society, founded at the end of 1894, had in April, 1895, eighty members. Its object is to have seances, lectures, discussions, and is open to all who recognize the truth of the so-called spirit phenomena, whatever the cause of them may be. Prof. Morenos of Venice argues for will as a force or entity distinct from the other forms of force and able to act against them. Fictitious sensations are proven to be transmitted. The *Revista* shows a tendency to refer to telepathic origin much, often ascribed to spirits, *i. e.*, the knowledge of an automatic writer really does come by telepathy from the things or events rather than from spirits. Spirit photography is regarded as not yet proven. In the *Psychical Review* a professor of physics expresses the belief that "we are very near to a discovery of a physical basis for immortality that will transform most all our thinking." Rev. M. J. Savage says: "Now I know that matter is sometimes moved without muscular contact," etc.; and again: "I have had communications while sitting in my study concerning things that were taking place 200 miles away. Over and over again such occurrences have taken place," etc. Rev. T. E. Allen, first secretary of the American Psychical Society, 1891, intimates that it desires to give a "thorough, candid and sympathetic sifting in this nineteenth century of ours" to "phenomena for which the great claim is made by many that they answer that wail of broken hearts, if a man die shall he live again?" The object of the society, as defined by its constitution, is to investigate "the phenomena of modern spiritualism in accordance with the scientific method." If spirit be a conscious entity dissociated from

matter, and immortality have no physical basis, then, an eminent American professor points out, "the earth would run away from the immortal part of man at the rate of about 25,000 miles per hour," so that spirit navigation would be an act of will instead of being possibly done by gravity without ghostly effort. Psychography, long distance clairvoyance, death prophesied in dreams, the divining rod, inspirational poetry, mysterious music revealed through clairaudience,—such are the themes of the *Psychical Review*, whose editor tells us that he deems himself peculiarly fitted to champion the spiritualistic hypotheses; believes himself, in fact, "inspired" to do it. This shows that although he urges the principle that "no state of consciousness is superior in authority to any other state," he still holds that some men are better for some things than some others — a principle which we venture to believe has much to be said in its favor, even were it a question of authority, for are we seriously told that if only "Messrs. Helmholtz, Huxley, Pasteur and Edison were simultaneously to announce themselves as converts to clairvoyance, thought-transference and ghosts, "there would be a prompt popular stampede that way?" There are proofs "entirely conclusive" for Dr. James that Mrs. Piper has shown in her trances a "knowledge of the personal affairs of living and dead people which it is impossible to suppose she can have gained in any other way. "Such things," he adds, "have broken down for my own mind the limits of the admitted order of nature. Science, so far as science denies such exceptional facts, lies prostrate in the dust for me; and the most urgent intellectual need which I feel at present is that science shall be built up again in a form in which such facts shall have a positive place." For Mr. Myers there is a reality in us far larger than we know, "an individuality which can never express itself completely through any corporeal manifestation." There is always some part of the self manifested, "some power of organic expression in abeyance or reserve."

Now let the reader turn from all this literature with its deep unconscious bias of prejudice, in the form of hunger for immortality, which weights every die of fact, where the atmosphere, though clearing up, is still murky with traces of nearly every form of superstition that the world has ever seen, to a book like Friedmann's on Illusion. The author, though a "nerve doctor" and a good clinician, is chiefly interested in normal psychology and philosophy and logic. His problem and method, which are all we here consider, are as follows: To collect with every possible detail and with as great accuracy as possible good typical cases of illusion, morbid and normal, including those of fabulists and phantastics, and then to study them from all points of view. The eccentric character and the tendency to regard or make them veridical, are parts of the illusion to be explained, and not data on which to base transcendental hypotheses. The structure of the self, the influence of feeling upon the evolution of the more complex illusions, their physical, psychic and hereditary root, are legitimate and right questions. Parrish's treatment, although he does consider briefly, but with negative conclusions, whether hallucinations are ever veridical, is also satisfactory.

If it be claimed that a folk-lorist gathering material from all over the world concerning amulets and charms, deems himself "called" to discuss whether they do really charm, or a student of spontaneous retinal imagery wants to ask if they are visions of things supernal, and claims "fair play" for these superstitions, or if a group of philanthropists wants to establish a mission or university settlement in the heart of ignorance and credulity to mitigate them—

we say merely that the energy could be better spent by better methods. It is curious that epistemologists who think that nothing is real but the thought of the individual at the moment, should feel impelled to "compensate" by holding that what used to be thought dreams, are really veracious of objective things. Is it a useful or a pernicious service to get fetishism, animism, etc., restated in current terms of science? When, if the nerve is severed that goes to my arm or leg, the two severed ends can never be put so near together that a volition to bend the limb can jump across the infinitesimal interval, is it likely that holophrastic impressions leap vast spaces? Again, is there no isolated conductivity among different fibres, or must we go back to the sixteenth century physiological sympathies? Science to-day, to quote a street song, has a great big swallow, but it can't quite swallow some things and continue to be science, and Clifford well said there were some theories a man could not verify without ceasing to be a man. The glory of the new psychology is not so much, as Mr. Myers thinks, that it is more exact, though that is of course true, but that its conclusions are more certain. So far from being less fit to open new fields and make fresh and great additions to the sum of human knowledge, than to make what was before known more precise, its chief claim is, the writer thinks, that it has first erected the ideal of collecting all the typical psychic experiences of man, his feelings, acts, ideals, normal and morbid, child and adult, criminal and law-abiding, and adding those of animals, and using all these as data, not to confirm any old longings or new theories, but for the most objective induction and painstaking study, fully persuaded, meanwhile, that the conclusions, whatever they may be and however long delayed, will be not only larger than all that can be sugared off out of spiritism, but that they will give us a vastly loftier and more adequate notion of all that can be called psychic. G. S. H.

V.—MISCELLANEOUS.

Mental Development in the Child and the Race. PROF. JAMES MARK BALDWIN. Macmillan & Co., 1895.

Professor Baldwin has treated in this book a subject that is new and full of absorbing interest. As the title would indicate, he has tried to do for the development of the child and the race what Darwin undertook for the animal series in his "Origin of Species." He simply applies the principles of evolution to mental development, and shows that what holds good for organic life is true also for mental life. It is in no sense a book for the general public; in fact the style of the author is such that he will probably never become popular with the masses. The book has already been reviewed in the public press several times, and the character of it is pretty well known. The task that remains for the present reviewer is to call attention to the points where the author has succeeded and to point out some respects wherein he has failed. He has so frequently appeared in several prominent journals, discussing subjects relating to children, that when this book was announced, it was looked for with considerable interest, as it was believed that he would carry out in more detail and with greater thoroughness the work inaugurated by Darwin, Preyer, Perez and others in the study of their own children. In this respect the public will certainly be disappointed, for after the first three or four chapters very few observations and experiments made upon his own or other children are given, and the book is devoted almost entirely to theorizing

and speculation. It is true that in many of the fields traversed by the author, no facts are yet established. But, then, why not have waited for them, or given time to gathering them, instead of elaborating theory in their absence?

The book opens with a chapter entitled Infant Psychology, in which there are a number of acute observations about taking up the subject, and the author shows a good understanding of what is to be done and the limitation of it. He next discusses the new method of child study, which is that of dynamogenesis. This is well presented, and the success he attains in using it in the study of color perception merits hearty approval. His criticisms on Preyer are thorough and just. He fails, however, to tell us the kind of colors he used, so that it is impossible for anyone to verify his results. The treatment of right-handedness is full of suggestion, and the author shows himself a master of the method he advocates.

Right-handedness is reduced to a spontaneous variation in the equality of the two hemispheres, and it is shown "that the influences of infancy have little effect upon it * * *"—a conclusion which must seem in the end unsatisfactory. The chapter upon Infant's Movements, in which he treats of tracery, imitation and the reflex movements in walking, is one of the best in the book. Certain details in his explanation might have received more careful consideration, but, on the whole, the chapter is most suggestive and full of interest, and will doubtless lead others to undertake further work in this direction. The use he makes of the child's movements as indicating his mental development, and the great stress he lays upon the motor side, will be the permanent value of the book.

When we come to the chapters upon the Theory of Development and Motor Attitudes, the author becomes entirely speculative, and the book loses the freshness of the first chapters. He takes up the various theories of development and considers them with care and acuteness, corrects and amends them, with the view to rendering them more plausible, broad and adequate. The suggestions he makes and the thoroughness with which he applies the principles of evolution, laying great stress upon "selective reaction," excess in motor discharge, pleasure and pain, heightened nervous discharge, the need for repetitions of stimuli, habit, accommodation, etc., when considered from a purely speculative point of view, will prove most valuable to future workers in the same line. The outcome of these chapters is to show that the principles of organic development are the same as those of mental development. The objections urged against the theories of Spencer and Bain will certainly find acceptance as being valid from a speculative point of view, and, while they are not supported by sufficient facts, there is something commendable in the attempt to find an hypothesis that will be applicable to both organic and mental life. The result will be to show that organic and mental life are one and the same and follow the same law of development. This is in the right direction. But the reader who wishes to find practical suggestions for beginning the work of child study or the study of race development, and hints as to the kind of thing that needs investigation, must feel not a little disappointed, and exclaim after finishing them, "Is this all there is to offer?" What is to be gained, after all, by this playing with theories, and by rendering them consistent and reasonable? The criticism against a theory that it seems unreasonable is not an absolutely decisive and convincing objection, and the contrary is also true that a theory that is reasonable is not certainly right. The author makes the very pertinent remark about the conflicting

opinions held concerning the inheritance of acquired habits when he says that none of them are disproved by fact. The same is true of his own theories; they are not only not proved, but they are not supported by a sufficient citation of facts and investigations. This theorizing is not a fault into which Prof. Baldwin has fallen by accident, but is a conscious and professed purpose with him. He says upon page 37: "Only the psychologist can 'observe' the child, and he must be so saturated with his information and his theories that the conduct of the child becomes instinct with meaning for his theories of mind and body."

Further: "That most vicious and Philistine attempt, in some quarters, to put science in the straight-jacket [the proof-reader should have made this "strait-jacket"] of barren observation, to draw the life-blood of all science—speculative advance into the secrets of things,—this ultra-positivistic cry has come here as everywhere else and put a ban upon theory. On the contrary, give us theories, theories, always theories! Let every man who has a theory pronounce his theory! This is just the difference between the average mother and the good psychologist—she has no theories, he has; he has no interests, she has."

Although I may be called a vicious Philistine, I must unhesitatingly pronounce this poor nonsense. I deny that the aim is to reduce science to barren observation, and I would make it something more than "speculative advance into the secrets of things." Theories are at bottom only working hypotheses, and beyond this they are of little service. This has been Prof. Baldwin's great mistake, and it has rendered his book in some parts a barren waste of speculation. It would have been well, for example, to have given us some facts that would have made it "perfectly certain that two in every three children are irretrievably damaged or hindered in their mental and moral development in school * * *"

In view of all this, it would be well to note the fact that the author tells us "there are only two ways of studying a child, as of studying any other object—observation and experiment." Does he himself not add and make use of a third, namely, speculation, when he says it is "theories, theories, always theories," that we want? All his views are borne out by trends in "current thought," "recent thought," "current theory," "current doctrine," "psychological theory," "biological theory," etc. These words are reiterated until the reader is fatigued. He says that parents and nurses may give results that are of some value, but there is the uncertainty whether they have not been colored by affection, pride, jealousy, etc. Scientific men are not free from affection, pride and jealousy with respect to their children or their theories; they are human beings. Although theories must, to a certain extent, precede experiments, they may vitiate them and lead the experimenter to overlook facts that come to view during the experiment. But since Prof. Baldwin has recently published an extended syllabus calling for general observations upon the social development of children, while he affects to distrust the "anecdotes of fond mothers," perhaps his objections are not to be taken too seriously.

In the chapter upon Imitation we are treated to more speculation. The author complains of the neglect the subject has suffered in "psychological theory," scarcely intimating that it needs "investigation." Imitation is defined as a phenomenon of consciousness, which "is probably never absent from living organisms * * *" It "is an ordinary sensori-motor reaction which finds its differentia in the single fact that it imitates, that is, its peculiarity is found in the locus of its muscular discharge." The first assumption is en-

tirely unfounded except upon the opinions of certain authors, and the second is a bit of wordy remark which adds little to the reader's information. It would have been much better to have cited cases of imitation such as the author must have observed in his own children, and come in the end to his conclusions from an analysis of these. That which the child imitates, "the copy," he says, is clearly defined in the child's mind before he imitates it and he proceeds by reproducing it; the opposite supposition, that by imitation a child clears up his idea of what is presented, can find much support, but he cites nothing to support his view. The whole matter of imitation is left practically where he finds it so far as permanent and established results are concerned, and, although he announces the crucial question involved in imitation, as it seems to me, when he says that it is concerned with a nature and significance of the copy which is imitated, he does not solve the question; he does not show how the copy brings about a reproduction of itself, whether it has the power to coördinate the muscles so as to bring about a reproduction or whether it issues in random movements, which are slowly corrected by comparing the movement with the original stimulus. These questions should somewhere find an answer in the light of observation and experiment and not of speculation and assertion. He approaches this matter on pages 378 and 379, and finally leaves it in a very unsatisfactory way by saying that the child does bring about a change in his reactions from senseless repetition to intelligent conformity to the copy which he imitates, "but he does it, and the least that this can mean is that there is in some way a modification of the impelling influence of his old associations." He shows how memory, association of ideas, assimilation and recognition, conception and thought, and emotion and sentiment may arise through imitation. In this he shows the same acuteness which has characterized his thinking in all other parts, but the confirmation is lacking as before. His suggestions at the end of his treatment of this subject, on how to observe children, refer almost entirely to the child's social surroundings. He notes an especially important point in the influence of companionship.

In the last few chapters the author discusses the rise of volition and voluntary attention, closing with a résumé of the theory of development. We have looked in vain for a thorough treatment of the origin of consciousness, either in the individual, the race or the animal series; it is assumed thoughout the book, and authorities are cited who hold that it is present in all forms of animal life. There is a vague promise in the preface that the matter will receive fuller treatment in the proposed volume of "Interpretations."

Many will find Prof. Baldwin's book stimulating; it clears up one's conceptions of many things and lays a stress upon others that will bring them into greater prominence and make them the subjects of investigation, but the author is not free from the regrettable and too common tendency to emphasize the indebtedness of the subject to his own contributions, and to contend over small points of priority. He picks a quarrel with a certain "well informed" biologist in the note upon page 247 about a small point; he charges Bain with using some of his views, (in Bain's words,) in a note upon page 196 and then quotes several dates,—also in a note upon page 317, to show that he was entitled to the authorship of a view which Ward had expressed, and in another case tells us that his ideas had been thought out several months before they appeared, and thus he was able to antedate his rival.

T. L. Bolton.

Thinking, Feeling, Doing. By E. W. SCRIPTURE, PH. D. Flood & Vincent, The Chautauqua-Century Press, 1895, pp. 304.

This seems a *ne plus ultra* in the way of popularizing, not to say vulgarizing, laboratory psychology. The frontispiece shows five American flags, as seen respectively by the red, green and violet blind, by totally color blind, and by normal eyes. Chain reaction is illustrated by a group of European monarchs and other dignitaries. The author's pictures and scenes from his laboratory often recur among the 209 cuts, and both are boomed with a sort of Sunday newspaper advertisement effect. All this, with the telegraph and Associated Press comments on petty variations in apparatus, or in their use, and the amazing number of new instruments as shown in the Willyoung catalogue, which emanated from the psychological laboratory, having the largest number of rooms of any in the world, certainly show that the academic study of the human soul has changed since the days of Upham, Hopkins and Hickok. Dr. Scripture wastes no time on such petty matters as form of expression or style. His book, he says in the preface, is an answer to the question once put to him, "Are you not afraid that all this accurate and fine work in the laboratory will scare away the public?" This suggests the question which staid and respectable Christians used to ask of the work of General Booth. But his homely and perfervid zeal had its own place in the world, and so has Dr. Scripture's book. Wundt he speaks of as "the greatest genius in psychology since the time of Aristotle." "No one else," he tells us, "has produced a book explaining the methods and results of the new psychology." "This is the first book on the *new* or experimental psychology written in the English language. That it has been written *expressly for the people* will, I hope, be taken as the attitude of science in its desire to serve humanity."

On the whole, we are not disposed to discuss the book in this light and sneering way, as do other reviewers of it we have seen. There are germs of thought and tendency in it which the "arm-chair" psychologist, to use the author's fit phrase, will do well to ponder. In the first place, Dr. Scripture is as anti-materialistic as they. Again, he well ridicules the current habit of translating mental processes into imaginary brain processes, as if brain dissection could explain facts of mind, or we could have a chemistry of anger. Again, he well says the day of individual systems is past, and it is soon to be as obsolete to speak of anybody's system of psychology as of so-and-so's system of chemistry. Psychology is now, he thinks, simply a great science to which all can contribute, and the day when the writing of voluminous general text-books will rank with painstaking and tedious investigation, or the reading of such books will be considered an education in psychology, is fast passing away. He would not have psychology longer deduced for philosophical prejudices. Both the faults and merits of the book are those incident to youth and to a new subject. Many of his devices in the laboratory, while by no means great inventions, are extremely convenient. Still more are of high pedagogic value in not only the popular lecture room, but in the college class room. The chief value of this little volume is that it is sure to make the teaching of experimental psychology, both in normal school and college, more effective, while for the author's pet foibles of exactness and precision, it is so needed a lesson to the "arm-chair" professors that we almost hesitate to quote Aristotle to the effect that it is the mark of a man unread and immature to insist on treating a subject with more exactness than the nature of the subject requires.

NOTES.

Feeling.

Of the eighteen papers read at the Princeton meeting of the American Psychological Association in 1894, seven were concerned with affective processes,—pleasure, pain or emotion. The technical journals have published many articles upon the same topics during the current year; and a book upon the "Feelings" is promised by Professor Ribot. This preponderance of interest in the affective side of mind is not by any means accidental. It shows that psychologists are realizing (what is indisputable) that experimental investigations of sensation and conation have been unduly preferred in the past, that feeling is not so well understood as association, memory, or attention. Somewhat unfortunately, more work has centred upon emotion than upon the simpler processes of pleasantness and unpleasantness: unfortunately, because to understand the complex, we must previously understand the simple. But this very fact suggests that it may be useful here to consider the defects which reviewers have pointed out in the most recent systematic attempt at a feeling-psychology, — the discussion by Külpe in his "*Grundriss der Psychologie.*"

Külpe recognizes the feeling qualities, pleasantness and unpleasantness, as elemental qualities of mind. His treatment is unsatisfactory in three respects: as regards the relation of feeling to sensation, as regards affective introspection, and as regards psychophysical theory.

1. Feeling may be related to sensation, the author says, in one of three ways. It may be an attribute of sensation; it may be a function of sensation; or, it may be a coördinate process. The first possibility is quickly, and (it seems) effectively, disposed of. The second is also rejected. From the logical standpoint, the reader may well be a little surprised at this. Had Külpe retained the activity consciousness, Wundt's apperception, intact, he would have been obliged to show the impossibility of functional relation between feeling and sensation (or, better, sense stimulus). But, apperception being reduced to something else, there is no logical necessity for the isolation of the two remaining elements: the discussion looks like a survival from a period of thought in which the activity consciousness was admitted to be elemental. To this it must be added that the actual arguments alleged are not entirely convincing; that the "serial method" of affective investigation demands a "certain dependency" of feeling upon sense stimulus; and that some measure of truth is believed by the author to reside in the "peripheral physiological" theory of pleasure and pain.

This difficulty is expressed somewhat differently by Dr. Meumann (*Année psychologique*, p. 511). "It may be questioned," he writes, "whether the three hypotheses formulated by the author are the

only possible alternatives. Could we not think of some other kind of relation as obtaining between sensations and feelings?" Külpe's three relations, indeed, may very easily be increased to five: feeling may be sensation attribute, a function of sensation, coördinate with sensation, dependent upon sensation in some way not functionally expressible, or—itself sensation. Dr. Meumann appears to have the fourth of these possibilities in mind; and it may have been suggested by Külpe's section on the serial method. The fifth we shall return to later.

2. Another point is emphasized by Dr. Martius (*Zeits. f. Psych.*, IX, p. 42). We must not neglect, he says, to analyze feeling, wherever possible, "from mere inner experience." But when we look to see how Külpe conceives of this analysis, we find but scanty indications. The dependency-formula of *sensible* discrimination is:

$$S\,D = \frac{\text{f A. E. P. B.}_1}{\text{g F. H. B.}_2}\ M.\ L.,$$

where *A* is attention; *E*, expectation; *H*, habituation; *P*, practice; *F*, fatigue; *B*, bodily processes; *M*, memory, and *L*, language. The dependency-formula of feeling includes *A*, *E*, *H*, *F* among its factors. But the formula cannot be written out as it can for sensation. Attention to the sense concomitants of the feeling intensifies it; attention to the feeling kills it (§39; 1, 2, 3). The same holds of expectation. *M* and *L* (not involved, however, if the expressive method is followed) are equally equivocal. Plainly, then, there can be no pure formula for any "affective discrimination;" while a mixed formula lays all the weight upon the sensible.

What are the facts? Can we "feel" differently, and express the difference, independently of sensation? If we can, what is the mechanism of the process? Külpe has analyzed sensible discrimination so successfully that our regret must be the greater that he has said nothing upon the point. So much, at least, seems clear,—that the "psychological methods" which he enumerates are not directly applicable to the study of pleasantness-unpleasantness.

3. The third unsatisfactoriness in Külpe's treatment is the obscurity and vagueness of his *theory* of feeling. He would apparently combine the views of Lotze and Wundt, making both more definite. But no definite propositions are offered. Here, however, it is rather our general ignorance of the facts than any cloudiness of the author's thinking which is to blame.

The fifth possibility, mentioned above under 1, was that feeling might *be* sensation. As there are not a few psychologists who favor this view, more or less explicitly, it will not be out of place to state the arguments urged by Külpe against it. They are briefly as follows: (*a*) Feelings have not, as sensations have, any objective significance apart from their subjective or psychological. (*b*) Feelings are far less dependent upon external stimuli than are sensations. They depend upon mental dispositions, which have their history. (*c*) The qualities of sensations are dependent upon the excitation of quite definite peripheral and (probably) central organs. The qualities of feeling evince no determinable dependency upon particular external bodily organs: of their relation to the central organ we know nothing certainly. (*d*) Feeling is blunted by practice and habituation in a way which differentiates it from sensation.

Until these differences have been resolved, there seems to be no choice but to accept feeling as ultimately distinct from sensation in the normal human consciousness.

Bibliographies.

Experimental psychology now possesses no less than three bibliographies. The *Zeits. f. Psych.* has published yearly indices since 1889; the *Année psychologique* and the *Psychological Index* have made a beginning with the literature of 1894. All three are imperfect, so that all three must be consulted; after consultation, the inquirer may look further for himself.

The existence of three yearly indices plainly involves much needless labor and expense. There is, moreover, an especial danger in the present instance. The *Psych. Index* for 1894 appeared in March, 1895. The *Année psych.* for the same year, advertised for March, seems to have been issued in April, 1895. The *Zeitschrift* index for 1891 is dated February, 1893; that for 1892, August, 1893; that for 1893, October, 1894; that for 1894 is unpublished at the time of this writing. It may very well be that the compilers of the latter, trusting that the *Psych. Index* is complete for American titles, and the *Année psych.* for French, will check their lists by reference to the two previously issued indices. Such a course would be most unfortunate. The *Index* is incomplete as regards the United States; while, on the other hand, its first three pages contain two French and two Italian titles (Nos. 22, 35, 46, 50) which do not appear at all in the *Année psych.*

Much better results would be reached by the formation of a central bureau,—and Germany has the claim of priority. For (1) the *Index* could then be made really complete, the compilers of the *Année psych.* being responsible, *e. g.*, for French, Spanish and Italian titles; the compilers of the *Psych. Index*, for English and American, and the German compilers for the rest. (2) International coöperation would render possible a sifting of the titles included in the bibliography, and would thus ensure the elimination of certain grotesque items in the present lists. (3) A less severe draft would be made upon the purse of the individual psychologist. And (4) the way would be paved for the incorporation of the psychological output in the "international catalogue of scientific literature" now mooted in the technical journals. Even if the work required a full year for its completion, proof-sheets, issued to subscribers as published, would be as valuable as the imperfect lists which are at present obtainable in March or April.

If the three indices continue to appear side by side, it is to be hoped that the *Année psych.* will in future refrain from translating foreign titles into French. The proceeding is contrary to every principle of sound bibliography. And as the great majority of the works catalogued have been competently reviewed antecedently to their listing, it is also to be hoped that brief characterizations and appraisements of their contents, over the reviewer's signatures, may be appended to their titles.

The Visual Qualities.

It has been customary to accredit sight with about 41,000 qualities of color and brightness. The scattered statements in the literature seemed to justify the assumption that there were some 800 distinguishable brightnesses between the limits of the deepest black and the most dazzling white; some 200 distinguishable colors in a solar spectrum of average intensity; and some 200 distinguishable degrees of saturation for each of these 200 qualities (not 800, as might be imagined, since brightness discrimination suffers very considerably by the intermixture of homogeneous with the mixed light); in all, 41,000, more or less, and probably more.

Professor König has recently computed the number of discriminable spectral colors, and the number of brightnesses from limen to terminus of stimulation (*Zeitschr. f. Psych.*, VIII, pp. 375 ff.). He gives the former as 160, the latter as 660. If these numbers are correct, the total falls to about 33,000. It may very well be, however, that Professor König has underestimated the number of qualities on the brightness scale.

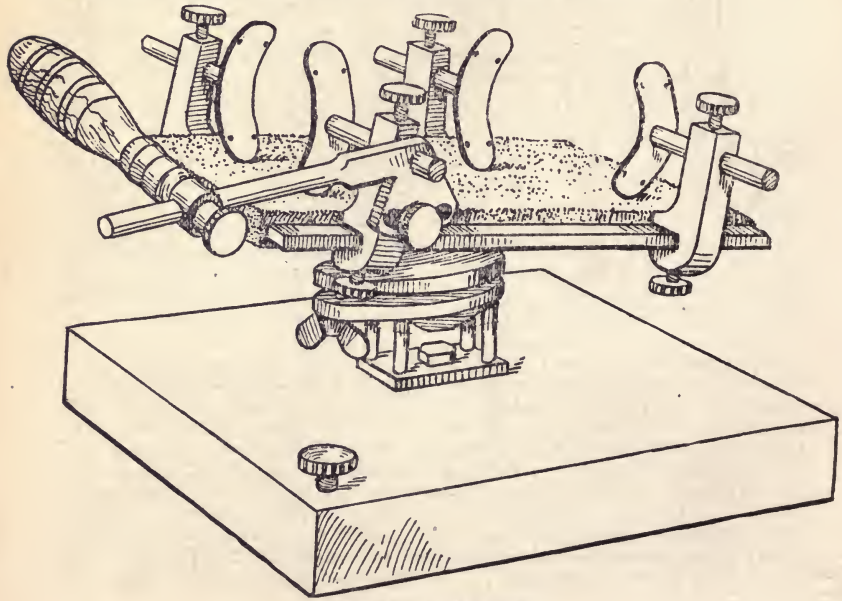
The Spectrum Top.

If a top composed of black and white sectors is rotated at a certain most favorable rapidity and in a certain most favorable illumination, the white clearly takes on the tint of the spectral color series, from red to violet. This fact has been recently discussed at length in various scientific journals; and Messrs. Newton & Co., of London, have even taken out a copyright on the manufacture of the requisite black and white discs for demonstration of the phenomenon.

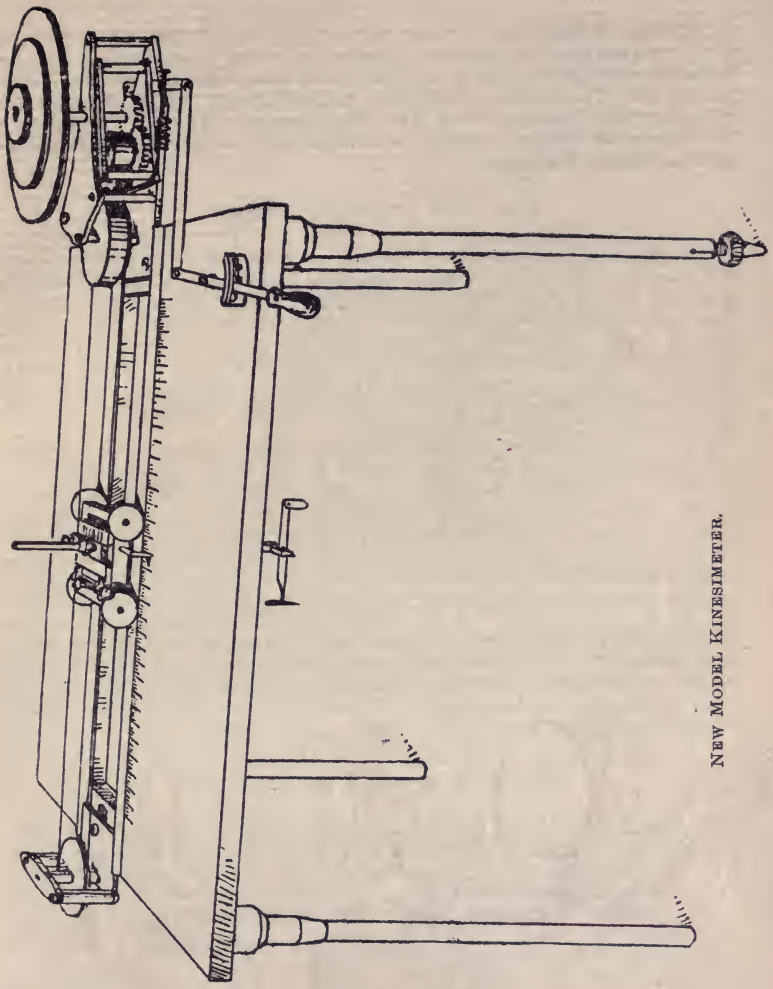
Professor Cattell has pointed out (*Science*, July 5, 1895) that the spectrum top was known to Fechner in 1838, and that an explanation of its colors has been offered by Rood (1860), Brücke (1864), and Aubert (1865). Aubert gives two patterns (*Phys. d. Netzhaut*, pp. 355, 378). Helmholtz also devotes some pages to the top, figuring two disc patterns (*Phys. Optik*, 1867, pp. 380, 381; new ed., pp. 530, 531). The demonstration of the subjective spectrum by its aid is a familiar experiment in psychophysical laboratories (*Cf.* Sanford's *Laboratory Course*, ch. vi).

The New Model Kinesimeter.

The following cuts illustrate the new model arm-rest and kinesimeter constructed at the Yale workshop for the Cornell Laboratory and described in the previous volume of the Journal.



New Model Arm-rest.



NEW MODEL KINESIMETER.

CONGRESSES, ETC.

The sixty-third annual meeting of the British Medical Association was held in London July 30 to August 2, 1895. Dr. Mickle was president, and Drs. McDowall, Nicolson, Rayner, Savage, Shaw and Weatherly vice-presidents of the psychological section. Discussions were held on the Treatment of Melancholia (introduced by Dr. Rayner), on Insanity in Relation to Criminal Responsibility (Dr. Maudsley), and on Epilepsy and its Relation to Insanity (Dr. Gowers). Papers were read by Dr. Bond on the "Relation of Diabetes to Insanity;" by Dr. Head on "Mental Symptoms in Relation to Bodily Diseases in the Sane;" by Dr. Maude on "Mental Symptoms in Relation to Exophthalmic Goitre;" by Dr. Reynolds on "Mental

Symptoms of Bodily Diseases;" by Dr. Shaw on "The Early Symptoms of Insanity;" by Dr. Campbell on "A Comparison of the Breaking-strain of Ribs in the Sane and the Insane;" by Dr. Percy Smith on "Voluntary Boarders in Asylums;" by Dr. Savage on "Insanity in Conduct;" by Dr. Shuttleworth on the "Operative Treatment of Idiocy;" and by Dr. Weatherly on the "Law in Relation to Single Patients."

The Late Professor Oliver.

The death of Professor J. E. Oliver of Cornell University should not pass unchronicled by psychological journals. Professor Oliver's interest in psychological questions is shown by his paper on "A Mathematical View of Free-will" (*Philosophical Review*, May, 1892), and by his participation in Miss Parrish's study of the cutaneous estimation of open and filled space (this JOURNAL, January, 1895). He also read the manuscript of Mr. Pillsbury's paper (published in the present number of the JOURNAL), having followed the investigation closely from its beginning.

Two of the problems which Professor Oliver had in mind for solution during the last two years of his life were psychological in nature. The first was that of the determination of the number of discriminable visual qualities (brightnesses and colors). He was keenly interested in the recent developments of optical theory, and especially in the question of the identity or difference of saturations and illuminations. The other—which was eminently characteristic of him—was that of attaching a mathematical or quasi-mathematical value to happiness. The ingredients of happiness were to be tabulated, by aid of the *questionnaire;* and these ingredients to be "weighted" in accordance with their statistical place in the whole series. The plan, if realized, would enable us to mark off the units upon what the Professor at the Breakfast Table calls "the dynamometer of happiness."

News from the Laboratories.

Professor Külpe, for many years Wundt's chief assistant at Leipzig, has been called to the chair of Philosophy at Würzburg. The University possesses at present no psychological laboratory.

Dr. E. Meumann, the author of important researches on the "time-sense" and on rhythm, will succeed Dr. Külpe at the Leipzig institute.

Professor Stumpf is busy furnishing a large laboratory at Berlin; and Professor Ebbinghaus will inaugurate one at Breslau. Dr. Schumann, who has been associated with Professor Müller at Göttingen, goes to Berlin, without habilitating, as Stumpf's assistant. Dr. Pilzecker (who has written on the attention under Müller's direction) succeeds Dr. Schumann.

M. V. Henri, one of the collaborators of M. Binet in the compilation of his *Introduction à la psychologie expérimentale*, is working for the Leipzig Doctorate with Wundt.

Dr. Marbe, the inventor of the new rotation apparatus, becomes assistant to Professor Martius at Bonn.

Professor Wundt is engaged upon a new edition of his *Logik*.

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SEX AND ART.[1]

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Introductory. In the following pages the attempt is made to connect, on a psychological basis, extremes, which as early as the time of Socrates[2] were felt to be in vital relationship with each other. In modern times, Schopenhaur[3] may be said to have treated the metaphysics of the subject, but its psychology, despite the increasing interest in each of the terms involved, has heretofore been neglected. The present article bases the connection on the one hand, the equivalence and interchangeability on the other, of the sexual passions (including the Anger-Fears) and the more intellectual instincts of Art, Religion, and the interests and enthusiasms generally, upon the fundamental quality of erethism found in every animal cell. The psychological expression of this bodily state is traced from its simplest manifestation, through animal combat and courting, the courting of the lower races, and the ensuing and accompanying religious, dramatic, and otherwise symbolic phenomena of Phallicism (all to be regarded as essentially subdivisions of courting) to the more complex conditions of modern times. Sexual perversions are regarded as atavistic degenerations, failures, or fetichisms of the psychological laws of courting. Modern art is represented as being

[1] In the preparation of this article I have much pleasure in acknowledging the kind and sympathetic assistance of Pres. G. Stanley Hall, by whom the subject was suggested, and with whom I conferred frequently in its elaboration.

[2] Cf. Plato's "Symposium."

[3] Cf. his doctrine of "Will (of which the focus is sex) and Idea."

the psychical expression of an erethism which is an equivalent, and historically a derivative, of that of sex; and as being therefore an overflow of some of the deepest emotions as well as a product of the intellectual capacities. A plea is thus entered for the emphasis of those activities which will form the noblest and most natural irradiations of this plastic and variable passion of sex. A full portrayal of the facts which support this view has not been possible within the limits of a single article. References are, however, made in sufficient number, it is hoped, to enable the reader to complete the picture by efforts of his own.

Erethism. The phenomenon of erethism is one which involves the most profound and varied elements of the bodily structure. It is indeed a constant accompaniment of animal life. The amœboid movements of the protozoa show this function in operation indifferently at any portion of the body and before the differentiation of any subservient structure, while the alternate erection and flaccidity of the metazoan cell, shown by Mosso, Hodge, and others, to depend upon nutrition and to correspond to states of activity and fatigue, carry this function into every part of the most highly developed organism. Among the higher animals this capacity differs with different tissues and groups of cells, with the age and constitution of the individual, and with sex, while it often seems to follow a certain rhythm not directly dependent upon the environment.

At no period in the life of the individual is the phenomenon of erethism more evident and more important than at the time of reproduction. Balbiani describes the extraordinary agitation of the paramœcia, which, he thinks, the want of nourishment is not sufficient to explain. "They seek and pursue each other, go from one to the other, touching with their cilia, sticking together for some moments in the attitude of sexual contact and then freeing themselves in order to join some other. These curious plays by which these animalcules seem to provoke each other to sexual union last often many days before they become final."[1] The conjugation of these animals depends, it is to be observed, upon the local erethism and erection of corresponding portions of their bodies through which their union is effected.

With the paramœcia there are no permanent sexual organs. The whole of the body is the medium of excitement, and the whole living contents of each body flow together and are individually lost in the act of conjugation. Among the metazoa, on the contrary, a portion only of the body is usually sacrificed,

[1] Beaunis, "Sensations Internes," p. 51.

but this sacrifice is accompanied normally by an evolution and loss of energy which profoundly affect the organism and which often result in exhaustion and sometimes in death. With the metazoa, also, as specialization advances, the sexual erethism becomes accented in certain directions. Definite sexual organs become developed. The reproductive glands, organs of intromission, of stimulation and attraction, make their appearance, while the nervous system, itself a highly erethic tissue, comes to bind together these different organs and unite them with the organism as a whole.

That the capacity for sexual erethism is closely connected with the physiological condition mediated in the higher animals by the sympathetic system, and that it acts and reacts upon it, is shown by the effect of climate, food, drugs, hunger, disease, age, and hereditary constitution, in favoring or retarding reproductive functions. The sympathetic nervous connection between the generative organs and the stomach and alimentary canal, for example, is one which is exceedingly close. Says Dr. Edward Tilt:[1] "The debauché and the roué are frequently at a loss for terms to express the annoyance of their sufferings at the pit of the stomach." These sensations—"of gnawing and tearing, sinking and faintness, rawness, not pain, but an irritation worse to bear than pain"—are due, he thinks, to the too great reaction of the sexual organs on the central sympathetic ganglia.

Drugs which stimulate the glandular activity, especially of the skin, act also as aphrodisiacs. The effect of baths in either stimulating or allaying sexual feeling shews the connection with the skin. Moderate muscular activity acts directly on the erectile muscles and indirectly through the nervous system. To quote LaGrange:[2]

> Bringing the muscles into action always produces important modifications in the processes of the great organic functions. There is an active congestion of all the organs during violent exercise, hence more active performance of function.

The indirect action through the brain may be of still greater importance.

> Stimulation of the brain may be very great under the influence of active congestion brought about by muscular action. It is possible to be made drunk by movement, and in certain brains predisposed either by their native organization or by exalted ideas or passion, muscular action is often the prelude to actions resembling those of intoxication and even of madness.

The effect that a muscular exercise has in thus extending a

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[1] "Change of Life," p. 96.
[2] "Physiology of Bodily Exercise," p. 28.

state of erethism may help to explain the apparently unnecessary activity of many animals preliminary to copulation.

Beaunis[1] notes the importance of the somatic background in sexual excitement. "Sexual sensations," says he, "are functional sensations. Here the whole functional apparatus appears to be constituted for the most lively and exalted enjoyment." The numerous nervous fibres and the end organs (genital corpuscles) are not, he thinks, sufficient to account for this. The cause must be sought rather in the relations which exist between the genital apparatus and all the other parts of the organism. These relations are very evident at the time of puberty. When the generative apparatus acquires its development, the other organs participate in the impulsion. This is due to the nervous connection rather than to that of the blood. Every modification of the sexual organs and every excitement will then have its effect on the nervous system and through it on the whole organism, nervous centres, voluntary and involuntary muscles, heart and vessels, glands, etc.,—everything is affected. As the local excitation gradually increases, so does that of the general system. One has all the conditions of an excess of functional activity and of exceptional intensity.

Clouston[2] gives an interesting case showing the intimate connection of the sexual erethism with the brain.

> A gentleman at the age of forty-nine had been for twenty-six years subject to regularly recurring brain exaltation every four weeks. The *nisus generativas* is greatly increased, and he says that if in that condition he has full and free seminal emissions during sleep the excitement passes off; if not it goes on. Full doses of bromides and iodides and sometimes a long walk will stop the excitement and sometimes not.

And in another place:

> American physicians tell us that there are some schools in Boston that turn out young ladies so highly educated that every particle of their spare fat is consumed by the brain-cells that subserve the functions of cognition and memory. If these young women do marry, they seldom have more than one or two children, and only puny creatures at that, whom they cannot nurse, and who either die in youth or grow up to be feeble-minded folk. Their mothers had not only used up for another purpose their own reproductive energy, but also most of that which they should have transmitted to their children. . . . . Why should we spoil a good mother by making an ordinary grammarian? [3]

Sex itself plays an important part in determining the erethic condition. According to Geddes and Thompson,[4]

[1] "Sensations Internes," p. 242.
[2] "Mental Diseases," p. 223.
[3] Cf. also Edward Clarke, M. D., in "Sex in Education," 1880.
[4] "Evolution of Sex."

we must recognize a male and female diathesis. The quality of "maleness" consists in activity, energy, variability, the production of a greater abundance of waste products, and is typified by the ever restless sperm cell; that of "femaleness" in quiescence, greater power of nutritive absorption, and less power to evolve energy. "The males are stronger, handsomer, or more emotional, simply because they are males, *i. e.*, of more active physiological habit than their mates. . . . The males live at a loss, are more katabolic — disruptive changes tending to preponderate in the sum of changes in their living matter or protoplasm. The females, on the other hand, live at a profit, are more anabolic—constructive processes predominating in their life, whence, indeed, the capacity of bearing offspring." The greater preponderance in the females of the higher animals of the sympathetic, and in the male of the cerebro-spinal system as well as his greater muscularity, would be a natural outcome of this difference.

Erethism of any kind in both male and female represents a katabolic crisis, and while depending upon a more stable past physiological condition, is itself disruptive in its nature. A sudden check in food will greatly increase multiplication among lower forms. In some cases "the female forms numerous germ cells and terminates her individual life by bursting." "Both Weismann and Goette note how many insects (locusts, butterflies, ephemerids, etc.) die a few hours after the production of ova. The exhaustion is fatal and the males are also involved. In fact, as we should expect from the katabolic temperament, it is the males which are especially liable to exhaustion. . . . In higher animals the fatality of the reproductive sacrifice has been greatly lessened, yet death may tragically persist even in human life as the direct nemesis of love."[1]

But not only of reproduction, of life itself it might be said that it is a masterly retreat toward the grave. The process of the years has nevertheless succeeded in bringing about a continually wider margin for the individual. We die, but we have learned to live in doing so. Hence it is not strange that the sexual life, rooted as it is in death, has become so richly provided with a margin of health and energy that its normal activity conserves and stimulates the organism instead of necessitaing its destruction. The moderate bearing of children, despite its physiological expense, is well known to be conducive to health. Minot[2] shews that with the guinea

[1] Geddes and Thompson, op. cit.
[2] *Journal of Physiology*, May, '91.

pig the production of offspring is a stimulus to growth. Neither should coition have an injurious effect. Says Lallemand, as quoted by Acton:[1] "When connection is followed by a joyous feeling, a *bien être général*, as well as fresh vigor; when the head feels lighter, the body more elastic and ready for work; when a greater disposition to exercise or intellectual labor arises, and the genital organs evince an increase of vigor and activity, we may infer that an imperious want has been satisfied within the limits necessary for health. The happy influence which all the organs experience is similar to that which follows the accomplishment of every function necessary to the economy."

Specialization. The movement of specialization in the sexual organs and the functions of erethism has had for starting point the reproductive cell. At first, almost any cell suffices as a germ. Later, tissues of comparatively undifferentiated cells are set apart, as ovaries and testes. Morphologically, these glands differ from others in arising from the mesoderm. Functionally, they are characterized by their capacity for erethism, their marked periodicity, and their reciprocal action upon the rest of the organism. During the mating season they are found to be greatly swollen and gorged with blood. In man, hysteria, epilepsy, and erotomania are closely connected with a morbid erethism of these glands, while their loss frequently causes profound physiological changes, more marked, indeed, than the loss of any other organ not necessary to the life of the individual.

But, although these glands are the starting point, and always retain their primary importance, it is not long before accessory organs are developed which, in awakening the superadded sexual activities, stand between the primary organs and the general system. Goltz,[2] for instance, has shown that with the male frog it is not the testes, but the pressure of the seminal fluid in the receptacles that directly leads to copulation. The testes may be cut or taken out (of the brainless male animal) without lessening his grasp, while section of the receptacles has an immediate effect. If, however, they are now filled with milk or other fluid, the old stimulus is again exerted. When other organs are developed, such as the prostate gland, ejaculatory ducts, erectile muscles, clitoris, penis, and vagina, these come to occupy a similar position with regard to the general system. Castration, for example, does not always incapacitate for sexual union,

[1] "The Functions and Diseases of the Reproductive Organs," p. 182.

[2] "Die Begattung des Fröches."

nor prevent masturbation. Ovariotomy does not always diminish sexual feeling. An inflammatory condition of the prostate is often the cause of sexual excitement, and of unduly frequent nocturnal emissions. Irritation of the glans, due to phimosis or other causes, sometimes precipitates the sexual orgasm. Excision of the clitoris is often successful in nymphomania.

The reflex connections of these organs, known to be situated in the lumbar region of the cord, must be connected with them as necessary to their functions, but while they are undoubtedly connected with the brain, nothing is known of the neural paths. That the brain acts as an inhibitory agent is shown by the erections and involutary emissions following decapitation of criminals.

Beaunis[1] states that "Tarchanoff has seen stimulation of the corpora quadrigemina in the frog immediately stop the coupling. The optic thalami, according to the researches of Albertoni, have the same function in the tortoise." Jacobson[2] quotes Eckhardt to the effect that by electrical stimulation of the crura, pons and upper cervical region of the cord, distinct erection of the penis could be produced, and states that—

> By other fibres the reflex act which constitutes erection may be inhibited from the brain. . . . While the influence of the brain in producing erection is evoked by sexual thoughts, or by sight, it is arrested or removed by vigorous mental employment or brain-work. The importance of the controlling fibres which run downwards from the brain is shown when these are interrupted by fracture or dislocation of the cervical cord. Priapism appears as soon as the effects of the concussion have passed away.

The sight, sound, odor, or merely the mental images of objects of desire are capable of producing sexual excitement. As Ribot says: "It is evident that impressions must reach the brain, since they are felt, and because there are centres from which the psychic incitations are transmitted to the sexual organs in order to arouse them into action."

It must be observed, too, that the accessory organs are sometimes quite remote from the primary glands, as in the male frog, where there is no intromittent organ, but where the arm and breast are highly sensitive to the shape of the female, easily distinguishing it from that of the male even when this is clothed in the skin of a female. The swollen thumb probably increases this sensitiveness in some way. The reflex apparatus is here lodged in the thoracic region.

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[1] "Sensations Internes," p. 50.
[2] "Diseases of the Male Organs of Generation," p. 479.

Removal of the skin of the breast and arm stops copulation, even when removal of the head fails to effect this purpose.

The complexity of a number of different parts united by nervous paths to subserve one function and, therefore, practically to form one organ, allows of great plasticity in their use and development. Some part of the system may drop out without preventing the function of the rest. In dogs, for example, there are no vesiculæ seminales, which lack is the cause of their exceedingly prolonged coition. In man the corpus spongiosum may be useless without destroying pleasure or capacity. Closely allied species present the greatest variety in their sexual organs. Among species of the same genus, parthenogenesis may be the rule in one, sexual reproduction in the other. Darwin notes that "secondary sexual characteristics are essentially liable to vary both with animals in a state of nature and under domestication."

Plasticity is better marked in the more recent organs of the system. Diseases of the urethra, the prostate, and the functions of erection are more common than diseases of the primary glands, and when these are affected, it is frequently due to the initial failure of some other portion, as when irritable prostate causes too frequent emissions, ending finally in impotence. The nervous connections which determine the length of the orgasm and the succession of the functions constituting copulation are still more easily deranged, and most easily of all the associations in the brain represented psychologically by sexual images and desires. That these last are not simply necessary reflexes, but superadded organs and functions, is shown by their persistence after the primary organs have been destroyed. The most libidinous of men, also, are often those who are entirely impotent, as if the sexual erethism had concentrated itself entirely upon the organs that remain.

The separation of the sexes and the gradual dropping of parthenogenesis is one of the most important stadia in the progress of life. Either sexual or asexual generation may occur among the protozoans, cœlenterates, worms, tunicates and arthropods, although it is only in some classes of the protozoans where sexual methods are not found at some period in the life of the species. The echinoderms, molluscs and vertebrata are always sexual. Hermaphroditism, where different sex organs occur on the same individual, is quite characteristic of primitive species. In many worms copulation occurs in pairs, when the male and female organs of each are brought reciprocally in contact, or in chains, when each

animal is in contact with two others, with the exception of those at the end. This exception is interesting as causing the inactivity of a male organ on one side and a female on the other, practically a monosexual arrangement and suggesting an evolutionary transition.

That the separation of the sexes always presupposes an underlying unity is indicated by many facts. The same organ in some species produces both eggs and spermatozoa, either at the same or at different times. Accidental or reversionary hermaphroditism, where one-half of the animal is male and the other female, the morphological correspondence of male and female organs, the male uterus, for example, are cases in point. In the frog, the testicles grow up round the ovaries, when if the sex is to be male the latter are absorbed. Even in the human embryo it is the sixth week before the sex can be distinguished.

As we ascend the animal scale, the reproductive instinct, although retaining its unity, becomes differentiated in two directions, primarily dependent upon the separation of the sexes and corresponding to their differences. On the one hand, the more anabolic, nutritive, feminine instinct of care for the young, on the other the katabolic, more erethic and masculine instinct of sex, originating in, radiating from, and culminating in the act of copulation. These two instincts mutually support and strengthen each other, and in man and the higher animals neither is complete without the full development of the other. They are both represented in either sex, although the sexual instinct is generally stronger in the male.

Radiation. The specialization of the sexual organs, as we have seen, is intimately connected with the development of the nervous system, and between this and the most recent or accessory of these organs, the bond of union, although not more fundamental and permeating, is yet more direct and close. As we ascend the animal scale, we find a number of organs more remotely but yet definitely connected with the reproductive functions, organs, to wit, of stimulation, prehension, and attraction, depending increasingly for their activity upon the higher senses and the brain, and giving rise to functions more distinctly psychological. In many cases portions of the body primarily developed for other purposes, such as hair, feathers, voice, etc., are turned to account in sexual stimulation and selection, and functions connected with the sexual life and developed under its influence may again become important in the immediate struggle for existence. Goltz, in his classic experiments on the frog, has shown that every part of the female exercises an attraction on the male, even little bits of flesh floating in the water.

"But," as Beaunis has it, "he was not able to determine by what sensitive avenue this attraction was exercised, since every organ of sense may be successively destroyed in different males without any of them ceasing to couple." Here, as elsewhere, the characteristic feature of sex is the law of irradiation, which might be stated as follows:

Starting from the act of copulation, the sexual instinct tends to widen and become more complicated, until the whole of the organism is involved in its activity.

This law is a necessary outcome of specialization and the erethism of sex. Sexual union is properly the climax of an erethism which involves the whole economy, but more especially those special organs of radiation, the brain and nervous system.

Many species quite low in the animal scale show traces of this feature. Annelids, snails, slugs, many crustaceans and insects betray unusual excitement at pairing times, and frequently possess "love-arrows" and other organs of stimulation not necessary to propagation, but serving to spread the erethism to the largest possible extent. In the higher animals sight and hearing, with their cerebral connections, take the place of other means of stimulation. With mammals the sense of smell occupies a position of importance, even in the highest species.

Selection. As the sexual instinct develops, concomitantly of course with the whole organism, the differentiation due to the separation of the sexes and the progress of irradiation becomes more apparent. Instead of a simple mutual approach, we find the male more generally seeking the female, fighting with other males for her possession, and actively displaying for her benefit his physical prowess and other charms. The differentiation of the sexual instinct, and its concentration in the male, itself tends to further radiation. Sexual selection now makes its appearance, and, according to either Wallace's or Darwin's theory, favors the descendants of those females which have the powers of comparison or observation, or whatever it may be, that leads them to choose, when they do so choose, the most capable, clever, and vigorous males. The direct rivalry of the males weeds out the inefficient, and here a relative tire or exhaustion of either the physical powers or the more psychical qualities of courage and endurance will have the same effect as complete defeat or death. Success is gained when the opposing male, for whatever reason, no longer feels like proposing. In relationship to the other motives of his being, the sexual instinct has been defeated. The relatively incapacitated male, even when he obtains a mate, will leave descendants less able in the struggle

for existence, and less likely themselves to continue their line of descent.

With the added inherited possibilities of irradiation and the increasing demands for higher physical and psychical qualities, the sexual instinct is thus being continually brought up to pass a new examination. When successful, it not only fills the old paths and satisfies their demands, but, true to its origin, carries the process still further on.

Combat. In the higher animals, the sub-departments of this examination are courting and combat, two divisions of the sexual instinct which mutually support each other, although one is often more predominant in a given species than the other, or may even obtain exclusive possession. But that one does not in most cases entirely supersede the other is shown by the fact that many birds and mammals continue courting after selection has been made. Those birds, *e. g.*, which are best provided with weapons of offense are also the most assiduous in courting. While stags are fighting, a doe will sometimes make her escape with another stag. The same is related of the capercailzie.[1] The fact, too, that so much of the combat is merely a harmless rivalry makes it difficult to say where combat ends and courting begins. At times they may even become identical. Both, at least, seem to go hand in hand, and demand the exercise of different sides of the nature of both the males and females.

The animal world is full of examples of the operation of these instincts. The males of spiders search eagerly for the females, and have been seen to fight for possession of them. When two male field-crickets are confined together, they fight till one is killed. The Chinese keep species of mantis in cages and watch them fight like game-cocks. Many beetles fight for possession of the females, and some, as the common stag beetle, are well provided for this purpose with great toothed mandibles, much larger than those of the females. The males of butterflies sometimes fight together in rivalry. Male sticklebacks fight furiously in presence of the females. They sometimes rip open their opponents with their lateral spines. "When a fish is conquered, his gallant bearing forsakes him; his gay colors fade away, and he hides in disgrace among his peaceable companions."[2] "The male salmon are constantly fighting and tearing each other on the spawning beds." The teeth differ with the sexes in many fish. Frogs have been observed fighting with much violence during the breeding season. Many lizards are very quarrelsome. The combats of a South American tree lizard usually end by the tail of the vanquished being eaten. "Almost all male birds are extremely pugnacious." The ruff fights much like a game-cock, seizing its opponent with the beak and striking with the wings. The great ruff of feathers is erected and serves as a shield. Bloody fights occur between the

[1] Darwin.
[2] Darwin, "Descent of Man."

males of the wild musk duck. Male snipe fight together, and the males of the common water hen fight violently for the female who looks on quietly. Peacocks sometimes engage in fierce conflicts. The black cock, capercailzie and many species of grouse and pheasant fight desperately at times. The game-cock has been known to fight when its legs were broken and afterwards spliced in order to enable it to stand until it received its death stroke. A few birds are believed never to fight, as with the woodpeckers, although the hens are followed by half a dozen suitors.[1]

The fighting instinct, too, underlies a great deal, if not all, of rivalry and courting.

"A sterile hybridcanary bird has been described as singing while viewing itself in a mirror, and then dashing at its own image. It attacked with fury a female canary put in the same cage."[2] This also shows the capacity of the secondary function to become dissociated. Male birds give plenty of evidence of jealousy of each other's singing. Chaffinches are habitually caught by playing on this instinct. The domestic cock crows after victory and "the humming-bird chirps in triumph over a defeated rival."[3]

Combat is of great importance among the mammals. Male hares, moles, squirrels, beavers, quanacoes, deer, and other timid animals often fight desperately during the love season. The canine teeth, as with "some antelopes, the musk-deer, camel, horse, boar, various apes, seals and the walrus," and horns, spurs and manes are specially developed for the purpose of combat. The pitched battles of stags are well known, and frequently end in death.

Courting.[4] The courting instinct, although the earliest forms are known among some of the most primitive species, appears to be somewhat more remote from the primary functions and more complexly associated than the instinct of combat considered by itself. There are many instances that make it appear that combat, or the passions based on combat,—anger, jealousy and fear—are very frequently submerged elements in the courting instinct. Courting may be looked upon as a refined and delicate form of combat, which latter may nevertheless often be appealed to as a last resort. The play upon the appreciation of the higher senses and intelligence which constitutes courting tends to become continually more remote from physical combat. And even where physical combat exists, it may really form an element in the courting instinct. It would be very difficult to prove that the real fights ending even in bloodshed do not have a stimulating and pleasing effect upon the female, and in many cases combat appears to degenerate into a mock battle, where the opposing male is

[1] Darwin, *op. cit.*, pp. 260-368.
[2] Darwin, *op. cit.*
[3] Darwin, *op. cit.*
[4] Cf. Tillier, "L'Instinct Sexuel."

either daunted and discouraged or the female influenced in her choice. In both cases the psychical equipment would be of a higher order. Combat by itself does not presuppose nor require any remarkable psychic effect of one sex on the other. Courting, even when resting entirely upon the male, presupposes appreciation or at least some effect of a psychical nature upon the female. The progress of evolution appears to show a movement towards the more irradiated and secondary although no less erethic instinct of courting.

Male bees, wasps, butterflies and moths are generally brighter colored, plainly for the purposes of courtship. In some insects, as with the glow worm, the male alone is provided with wings, and there is generally a superfluity of males, facts which induce either combat or courting. In many of the coleoptera the sexes differ in color, so much that they have sometimes been classified as different species, and they are often provided with protuberances which serve as ornaments.

Among fishes there are many instances of courtship and display. The Chinese macropus expand their fins, which are spotted and ornamented with brightly colored rays.[1] The splendid colors of the peacock labrus, in one species of the genus at least, differ greatly according to sex. In two species of ophidium the "males alone are provided with sound-producing apparatus."

Among frogs and toads it is principally the male which croaks. Sometimes they alone are provided with resonant sacs. The male alligator strives to win the female by splashing and roaring. "Swollen to an extent ready to burst, with head and tail lifted up, he spins or twirls round on the surface of the water, like an Indian chief rehearsing his feats of war."

Male snakes can generally be distinguished from females by their stronger colors. Male snakes are provided with anal scent-glands, which as the males follow the females, Darwin thinks, probably serve to excite or charm. The rattle of the rattle-snakes is used as a sexual call. The crest of many lizards is much more developed in the male than in the female. In the genus satanas the males alone are furnished with a large throat-pouch, which can be folded up like a fan, and is colored blue, black and red; their splendid colors are exhibited only during the pairing season. The changing colors of the chameleon show the increased excitement of the male during the pairing season.

In birds the courting instinct is very well developed, giving distinct and wonderful examples of appeal to the higher senses

[1] Darwin, *op. cit.*

of sight and hearing, and rising beyond the passive pleasure of these senses to a most complex association of sound, sight and movement in their stated dances and parades. Because of the direct appeal to the senses as distinguished from the more irradiated powers of sensibility in general, the courting instinct is more decidedly in evidence among the birds than with the mammals, although it may very well be true, as is indicated by their more permanent affections, that the mammals have a more inner and heartfelt ecstasy, and that their display and appreciation are not so prominent, simply because they are more rapid, deeper, and more penetrating. The wonderful way in which dogs are able to divine their master's meaning, judging from the slightest indication of eye or hand, shows the unobtrusiveness, but no less the effectiveness of their sensibility.

Male birds "are ornamented by all sorts of combs, wattles, protuberances, horns, air-distended sacs, top-knots, naked shafts, plumes and lengthened feathers gracefully springing from all parts of the body." The beak and sometimes the iris of the eye are more brightly colored in the male. The fleshy appendages about the head of the male Trapogan pheasant swell into a large lappet on the throat and outer two horns, which become colored a most intense blue. The African hornbill inflates a scarlet wattle on its neck. The wattles of the turkey cock swell and assume vivid tints while courting. The immense variety and wealth of form and color in the feathers of birds are too extensive and too well known to admit of much detail. The greenfinch, sparling, magpie, stocking-weaver, heath-lark, mocking-bird, falcon, Virginian night-hawk, stone-smacker, blackhead, tufted titmouse, golden pheasant, cock of the rock, bower-bird, and many others have often been cited in evidence of the ecstatic movements and brilliant displays of birds during periods of sexual excitement. Many species of the gallinaceæ give good instances of the power of the courting instinct and the way in which it is related to combat and ecstasy generally.

In the case of the woodgrouse[1] the hens are less watchful than the cocks (because they are spared by the huntsmen), and become quite tame at pairing time. The cock the whole year round is very quarrelsome and is always fighting with those of his own sex, and is very imperious and violent even with the hens. The more amorously he has demeaned himself at pairing time, the more indifferent he becomes afterwards to his mate. Sometimes he falls upon her and injures her without any apparent reason.

The woodgrouse begins to "balz" in the earliest spring, when as yet everything is quiet in the woods. The cocks, who have formerly been isolated, collect themselves upon a certain place, generally a

[1]Brehm, "Thierleben," Band 6, p. 33.

southern slope grown over with underbrush. The hens also in the neighborhood come for the purpose of attending these amorous plays and of obtaining a mate. Both sexes come about seven in the evening, silently except for the whirr, and light upon isolated trees. After the cock has alighted he remains for some moments perfectly motionless, observing everything with the greatest attention, at which time the smallest noise which appears suspicious will cause him to fly off again. If everything is still, he gives a sound something like the grunt of a young pig, which is taken as a sign of good weather by huntsmen, as the balzing will then likely take place in the morning. Sometimes, however, it happens that the cock begins to balz, immediately descends to the ground, struts before the hens found in the vicinity, and ends by covering them. Ordinarily, however, the balzing begins not before the first streak of dawn, *i. e.*, about three o'clock. When the balzing begins, the head is stretched out, the wings somewhat held down and out from the body and the tail raised. During the "rattle" (of the song) the cock customarily runs along the branch on which he is perched; during the "slurring" he bristles up his feathers and twists himself around. But this order is not always followed. There is considerable variation of the "rattle," the "slur" and the "head note," the same cock sometimes changing from one way to the other in the same morning. The first note begins "töd," then follows töd, töd, töd, töd, and finally becoming quicker, töd, öd, öd, öd, öd, until the "head note" "gluck" is uttered, which is stronger than the rest. Then begins the slur. This "slur" lasts 3½ or 4 seconds. Exceptionally some cease with the "rattle" before the "top note," others after it, and others in the middle of the "slur." Every new "slur" excites the bird more and more. He goes up and down the branch, lets his excrement fall plentifully, grasps in the air with one or the other claw, springs from one branch to the other, or "*steht nach kurz*," as the hunter says, and finds himself in a kind of ecstasy, in which everything around him is forgotten. This goes so far that the report of a firearm does not trouble him even at short range. At the "slurring" all woodgrouse are very hard of hearing, but it is somewhat otherwise with sight. The spark of the firearm alarms him. A white handkerchief waved under him causes him to cease in the middle of the "slur" (which seems to be the most ecstatic part). Brehm believes this comparative blindness and deafness are due to the excessive "heat" or sensuousness which moves the bird at this time. When the bird "sings" in captivity, it is observed that during the "slurring," the head and neck are stretched out and the nictitating membrane is half-drawn over the eyes. There is some proof that the birds really hear, but do not regard, *e. g.*, a case where the bird turned his head when a gun went off, but did not cease the ecstatic slur. The birds, too, are very fearless during this whole period, and will run out at men and horses sometimes. When the hand is brought before the bird even in the middle of the "slur," he pecks at it. An old cock will not allow any young one nearer than a circle of about three hundred paces, and fights with any opponent; not unfrequently one or the other is killed. Geyn says young cocks crow very lightly in the neighborhood of an old strong hero of the lists.

The climax of the balzing is just before the sun rises. When there is a moon, the balzing is more vigorous. After the day has fully broken, the cock ceases and joins himself to the hens, which are to be found a short distance around. At times it happens that a female draws near to the balzing cock and invites him with a tender "bak" "bak" to herself. He cannot resist this an instant; he falls

like a stone from the tree, and dances in a wonderful manner upon the ground. Customarily, however, he must seek out the hens and not seldom flies a considerable distance around after them. Once near the hen he balzes and dances, finally covering her as she is cowered upon the ground. How many hens he is capable of covering in a morning is not known, as a cock seldom has more than three or four hens. The hens appear to have more inclination to some cocks than to others, which occasions severe fighting, in presence of the hens and on the ground. In the third or fourth week of the balzing the cocks leave the balzing place and go back to their often distant feeding places, and the hens begin to build their nests in separate places. When food is plentiful in the fall, the cocks go together in troops.

Courting and combat may both become dissociated somewhat from copulation, a fact which harmonizes with the increasing complication and plasticity of the higher functions of the sexual system. Many male animals fight whenever they meet, although their conflicts are more intense at the breeding periods. Pouters are trained to show at the sound of the owner's voice. A cock and a hen are placed in boxes with a partition between. The owner approaches, makes a peculiar call, and raises the partition. "The birds generally put themselves into the best and most striking attitudes. They soon come to associate the sound of the owner's voice with the expectation of seeing their mates, and will begin to fill their globes and strut about with delight." Later on the voice is all that is required.[1]

Mr. Hudson[2] gives us among others the following case of evident dissociation. From the point of view of art, it is interesting to observe that this occurs when the irradiation has become highly complicated and therefore more readily plastic and controllable.

A strange performance is that of the spur-winged lapwing of the same region, which occurs at frequent intervals, especially on moonlight nights, all the year round. These birds live in pairs, but one of a pair, leaving his mate to guard the nest, will rise up and fly to a neighboring couple, where it is welcomed with notes and signs of pleasure. Advancing to the visitor, the receiving couple place themselves behind it. Then all three, keeping step, begin a rapid march, uttering resonant drumming notes in time with their movements, the notes of the pair behind being emitted in a stream like a drum roll, while the leader utters loud single notes at regular intervals. The march ceases; the leader elevates his wings and stands erect and motionless, still uttering loud notes; while the other two, with puffed out plumage and standing exactly abreast, stoop forward and downward until the tips of their beaks touch the ground, and sinking their rhythmical voices to a murmur remain for some time in this posture. The performance is then over, and the

[1] Robert Fulton, "Illustrated Book of Pigeons," p. 126.

[2] "Music and Drama in Nature," *Longman's Magazine*, 1890, Vol. XV.

visitor goes back to his own ground and mate to receive a visitor himself later on.

As we have already noticed, combat is the leading feature of sexual selection that can be readily observed among the greater part of the mammals. To the result of this, however, the female must lend her sanction, and must herself be willing in the most of cases to belong to the conqueror of the lists. When she is not, combat and possession are of no avail. A female could easily avoid union by flight or go off with another male if she so desired, as, indeed, sometimes occurs. The male is frequently in heat when the female is not, and her refusal is then always effectual. The males of dogs are ready for copulation at all times, but union never occurs until the females are themselves in heat.

It seems difficult to tell what the characters are that influence the female mammal in her choice. In contrast with the birds, they are not characteristics which immediately appeal to the outer sensibility. They seem to depend rather on some sort of interpretation of the sensuous impressions and appeal rather to the higher capacities of the brain. Cases, however, are not wanting where characteristics are developed which appear to be of service as sexual charms. Odors, as already mentioned, are of great importance among the mammals. "Large and complex glands furnished with muscles for uniting the sac and for closing and opening the orifice have in some cases been developed." The males of certain antelopes are provided with erectile ridges of hair running along the back, which can hardly be of service as a defense in battle. Many species of quadrumana have very ornamental hairy crests upon the head. The beards of goat and ibex and the whiskers and beards of many monkeys are confined to the males. Many male deer are considerably different in color and possess brighter markings than the females. The young approach the female color, and castration frequently prevents the development of the special characteristic. The voice of the male is generally stronger, and sometimes special sacs are developed which increase the sound, as with some species of deer. With the quadrumana, although the sexes generally resemble each other, there are so many odd and curious variations of form and color that it is difficult to believe they are not serviceable as sexual lures.

As we have seen, the phenomena of courting are exceedingly complicated. On the part of the female, definite courting appears to assume two contradictory impulses, to receive the male and to repulse him. Espinas[1] explains the refusal as a length-

[1] "Die Thierischen Gesellshaften," p. 267 and ff.

ening out of the pleasure on her part. "The following of the males, says he, must awaken in the females a more or less definite image of sexual union." "This pursuing of the males is also in itself a pleasure, and there is no lack of examples in the animal kingdom where a satisfaction is intentionally protracted or put off in order to extend the enjoyment * * *. So the cat plays with the mouse, the otter and cormorant with the fish * * *. For the same reason the females must put off the males because they feel the pleasure of being sought, and are able to wish for the lengthening of this pleasure."

But there are many cases which show that the female is really moved by an underlying timidity, fear, or even dis-like, instead of a desire for pleasure in thus lengthening courting. Very often the female heat is some days or hours later than that of the male. His excitement, expressed in movements of various kinds, is naturally communicable, especially in the higher animals, and the erethism thus flows over from the male to the female. Or, in other words, the instinct of fear and dislike is overcome by love. While males are fighting or displaying their ornaments, the females frequently look on quite unmoved, as with the females of black cock, who walk off into the underbrush, where they have afterwards to be hunted up by the male. Darwin observes that in many cases appearances would lead us to believe that the female selects "not the male which is the most attractive to her, but the one which is the least distasteful." Courting is often continued after all rivalry has ceased, and appears in many cases to help overcome the natural passivity of the female, as we saw with the capercailzie, who runs out from her cover to meet the male.

Fear and Anger. There is, however, more than the demand of the female which leads to courting. If the higher forms of courting are based on combat, as we have already suggested, among the males, at least, anger must be intimately associated with love. And below both of these lies the possibility of fear. In combat the animal is defeated who is first afraid. Competitive exhibition of prowess will inspire the less able birds with a deterring fear. Young grouse and woodcock do not enter the lists with the older birds, and sing very quietly. It is the same with the very oldest birds. Audubon says that the old maids and bachelors of the Canada goose move off by themselves during the courting of the younger birds. In order to success in love, fear must be overcome in the male as well as in the female. Courage is the essential male virtue, love is its outcome and reward. The strutting, crowing, dancing, and singing of male birds and the preliminary

movements generally of animals must gorge the neuro-motor and muscular system with blood, and put them in better fighting trim. The effect of this upon the feelings of the animal himself must be very great. Hereditary tendencies swell his heart. He has "the joy that warriors feel." He becomes regardless of danger, and sometimes almost oblivious of his surroundings. This intense passionateness must react powerfully on the whole system, and more particularly on those parts which are capable, such as the brain,[1] of using up a great surplus of blood, and on the naturally erethic functions of sex. The flood of anger or fighting instinct is drained off by the sexual desires, the antipathy of the female is overcome, and sexual union successfully ensues.

Some animals even seem to play upon this fighting instinct. Darwin mentions the case of a female of the cape buffalo fighting with the male. They pushed each other about quite violently. He observes, however, that the bull never used his horns in a serious way, and could easily have ended the fight if he had so desired.

In their general relationships, the anger-fears and sex seem each to be large systems of overt or partially inhibited reactions, connected with each other much in the same way in which Fig. 2 represents the reciprocal reaction of r and r^1. Within the limits of this article, it is of course not our intention to study the anger-fears in detail, nor to show their equivalence and interdependence with sex, except when and in so far as they are subordinate, and aid in the discharge of the sexual functions.

Sex and Care for Young. Although the function of reproduction is the starting point of both the sexual instinct and the instinct of care for the young, and although the latter of these has added immensely to the complexity of life and to its higher psychological processes, it seems to be somewhat late in the series before these two great instincts can be said to be distinctly connected. The care that many animals exhibit for the product of impregnation does not appear to grow directly from the desire for copulation, and it would be presuming extraordinarily upon the representative powers of the lower animals if we should say that the desire for offspring determined that for copulation. It seems more probable that care for the young grows out of the care of the individual for its own body, and that the offspring, which has been for a time a portion of herself, is defended by the

[1] This would obtain even although the cubic contents of the skull are unchanging—rapidity of circulation taking the place of an accumulation of blood. Cf. Bayliss and Hill on "Cerebral Circulation," *Jour. of Physiology*, Sept., 1895.

mother with a fervor which arises almost directly from the instinct of self-preservation. Natural selection would operate favorably on any such attachment, both on account of the preservation of the offspring and the reaction on the parent, in whom becomes cultivated an experience of wider relationships and a better power of dealing with her environment. The mother that so extends herself to her offspring that she sees for it, hears for it, and provides for it in many ways, becomes herself more highly developed. The parallel development of organs capable of retaining and nourishing the impregnated egg, although they do not appear themselves to be dependent upon the motherly instinct, yet by producing offspring which is larger and more perfect, both add strength to the original feeling of bodily identity and provide a further appeal to the instinct based upon it. Where the instinct of care for the young affects the father also, or devolves entirely upon him, the scource of the instinct must lie in another quarter.

Let us take an example. The male stickleback, whose very violent combats have already been noticed, builds for the female a nest, in some species made of agglutinated sticks, a burrow of stones in others, both of which serve to accumulate the eggs, which are fertilized by the attendant male. After the eggs are fertilized, however, the male continues to watch over them until they are hatched and the young grow of a certain size. His pugnacity serves him in good stead, and enables him to defend the nest against marauders, none of whom are more troublesome than the female stickleback herself, who would readily eat her offspring unless driven off fiercely by the male. How is it possible that the instinct should be developed?

In the first place, as Espinas notes, the eggs of fish must generally be fertilized within five minutes of their emission—otherwise they die. Hence the male fish follow closely upon the issuing ova, which must be frequently in his field of vision, and become an object of attention and regard. That this is so of some fish is shown by the Chinese macropus. "After the male has won his bride, he makes a little disc of froth by blowing air and mucus out of his month," into which he collects the fertilized ova, guards them and takes care of the young when hatched.[1] When the courting of the male has influenced the female stickleback to enter the nest built for her, it is not unnatural that his attention will become directed to the eggs. Indeed, it would appear that this may always be an element, as fish are gen-

[1]Darwin, *op. cit.*

erally ready to eat the eggs and young of other species. The desire must, therefore, be inhibited in the males at the spawning times, at least as far as eggs issuing from the female are concerned. Such a regard for the eggs, handed down for generations, and favored as it would be favored powerfully by natural selection, might very readily issue in the instinct of the stickleback.

It would appear that in this case the instinct of care for the young has grown directly out of the sexual instinct, and may be regarded as an irradiation of it. The percepts necessarily associated with the acts of fertilization, have become the basis of a care which continues after the acts of fertilization themselves have ceased. The instinct of the midwife frog already referred to may have originated in a similar way. With the female of the Surinam toad, who carries her young on her back, the instinct probably originated with the male, since it is he who takes the fertilized eggs and places them in the dorsal pouches, where they hatch. If this action of the male originates as an irradiation of the sexual instinct, the further irradiation to the female is of considerable interest. The habit of the male ostrich, who collects the eggs laid by the female and hatches them entirely by himself, would not seem to be directly connected with the sexual instinct, as these acts are not associated with copulation. They might rather be residua or survivals of a time when both sexes sat upon the eggs, as is customary with many birds. It is possible, however, that this habit itself (of the males helping the females with the care of the eggs and young) may be a sexual irradiation. The instinct having been already established on the part of the female, and when the natural irradiation of the sexual passion in the male has led to the repetition of sexual acts with the same female and the association of impulse and impressions which results in pairing for however short a time, this interest in the female might very readily be extended to the offspring which belongs to her, and which she is so ready to provide for and protect. Espinas notes that among birds it is precisely the least intelligent which abandon the female after copulation. To this they are led, he thinks, by the unassuaged ardor of their passions, and by the fact that they have not been able in the "time too short of a brutal pursuit" to impress the image of the female sufficiently deep to be a means of attachment.

The paternal instinct would not, then, be at the bottom, care for the young, but an irradiation of the characteristically male instinct of sex, through the female to the young themselves. This, however, would generally occur only when development had proceeded to a considerable extent, and

comparatively late in the phylogenetic series, a fact with regard to the paternal instinct which has been frequently recognized. Cases like that of the stickleback or Surinam toad are exceedingly rare, and it is not until we reach the birds and mammals that we have any well marked instinct of care for the young, and in these classes the female undoubtedly leads. Indeed, among many quite highly developed species, as with the capercailzie, the males take no part in guarding the nest or rearing the young. With the paternal instinct, when it has really come in, as with undoubted sexual characteristics generally, there seems to be a great deal of variety and plasticity. In certain species the male may play a very considerable rôle, while in closely related forms he takes no part whatever. Species of grouse, which sometimes cross with the capercailzie, assist the hens in the protection and rearing of the young. The lion trains his pups, while the tiger is said to be eager to destroy them.

In polygamous or gregarious species, the males will easily come to associate the already considerable number of females with the additional young ones, and to extend the interest and protection which he originally owes to his wives to their offspring also. Bulls among wild cattle form a ring with the females and the young in the centre when danger threatens. Stallions do the same. Boars in India defend the herd against leopards and other animals except tigers. Stags protect their families from other animals as well as from males of their own species. With the llamas[1] each troop is composed of one male, with several females and their young. The male grazes at some distance from the flock, and is continuously on the watch. When danger threatens, he issues a warning cry, all the heads are raised, and when there is necessity the herd takes to flight. The females and young go before. The male follows them and often pushes them with his head. If the male is wounded or killed, the females run round him, making a whistling noise, and allow themselves to be killed rather than flee. If a female is killed the herd does not stop.

With many monkeys the strongest male becomes the guide and protector of the band. He demands absolute obedience and enforces it under all circumstances. His subjects are always ready to pay court to him, and apply themselves with the greatest zeal to freeing his hair of troublesome parasites, to which operation he lends himself with a grotesque majesty. In return he watches faithfully over the common safety. He is always the most circumspect. His eyes wander constantly

[1] Brehm, *op. cit.*

from one side to the other. He distrusts everything, and he nearly always succeeds in discovering in time the danger which threatens the troop. Darwin quotes the instance of a band of baboons who had been surrounded by dogs, and who had with difficulty made their escape, "excepting a young one about six months old, who, loudly calling for aid, climbed on a block of rock and was surrounded. Now one of the largest males, a true hero, came down again from the mountain, slowly went to the young one, coaxed him, and triumphantly led him away — the dogs being too much astonished to make an attack." In these cases the male is very jealous and drives away all other males when they arrive at maturity. His care for the young seems to be founded upon his desire for the continuous possession of the female, and is thus certainly an irradiation of the sexual instinct. It is very interesting that in some cases this accessory instinct should be more effective in the protection of the young than the instinct of maternity itself. While the care for the young on the part of the male is, in many cases, a derivation of the sexual passion, this does not hold true of the female, nor is there a reciprocal radiation, except perhaps in man, which places the maternal instinct at the basis, making the desire for offspring lead to a desire for sexual union. On the contrary, in both sexes the desire for union is primordial, and in the male, if the present view is correct, it is also basal, while in the female, care for the young is derived from the love of her own body and is much more independent of the sexual passion.

The Æsthetic Capacity. Whatever variety of different passions play together in composing the final erethic movement of sex, no one can read of the operation of the sexual instinct in the lower animals without being struck with the wealth and abundance of the striking, the attractive, and the beautiful, with which this instinct is closely connected.

Whether these have been wholly produced by gradual selection on the part of the females or not is not necessary to our purpose. There may very probably have been many different agencies at work. The different physiological constitution of the sexes would result naturally in a predominance of bright colors (due primarily to overabundant waste products) and of more energetic movements. It seems, too, very possible, as Wallace supposes, that natural selection would operate in cutting off the less active females of brighter color, while the males would be able to save themselves, and thus propagate their kind. But with the development of the higher senses and the brain, it would seem very unnatura indeed, if the female should not be closely attentive and deeply moved by the caresses, the showy movements, the

gorgeous colors, and the singing of her mate, and that special excellence in their qualities would not have the effect of charming and attracting her and of overcoming her objections to the sexual act.

It has been supposed by some that the bright colors of the males have originated as signs of recognition and that to this they still owe their great variety in closely allied species. But it would seem that animals, as highly developed as the birds and mammals, are capable of recognizing very fine points of difference, especially when the objects concerned are part of their customary experience. Most game birds know very quickly the difference between a man with a gun and a man without. Young chickens make no mistake about seeds found in sand of a very similar appearance. A ram distinguishes another ram immediately from a ewe even in hornless varieties. Wild boars give a different sign to the herd on the approach of a leopard, from that given when a tiger is noticed.

In many cases, too, it is not the parts of the body most easily seen which are the most striking or beautiful. A great many birds are quite dull on the back, but have beautiful markings on the under surface of the breast and wings, as with our common nighthawk. The beautiful ball and socket designs on the under surface of the wing of the male Argus pheasant are only displayed when the bird purposely holds up his wings, which he does when courting, and so on in numberless cases, some of which have been already referred to. There must be a great deal more at work than the necessity the sexes are under of distinguishing each other at a distance. For this, much slighter modifications would suffice, and any increase beyond the minimum would be dangerous in the struggle for existence. It may very well be, however, that in earlier times and yet among more primitive species, a slight difference would be of advantage in enabling the sexes to find each other. If even a small per cent. were more successful on this account, it would tend to perpetuate the characteristic. It has been noticed by many authors in this connection that singing birds are found more frequently in thickly wooded countries and are not brightly colored, while the birds of brilliant plumage are found where they are able to be seen at a considerable distance.

It is to be noticed, also, that bright colors and energetic movements are a sign of health and vigor, and on this account their selection by the female would benefit the species and thus tend to its expansion and survival. This may very well be the *meaning* of these love displays, but we can hardly suppose that the female is capable of such powers of repre-

sentation as to enable her to understand this relationship. When she chooses, it is not because she realizes that her mate is the most vigorous, but simply that he is the most pleasing. In brightly colored species, *e. g.*, it will be the sign and not the thing signified which occupies her attention. Indeed, it will not be a sign to her at all, but simply the stimulus of pleasure and delight. Even with the mammals, with their greater capacity of interpretation, and their advance beyond the simple appeal to the outer sensibility of eye or ear, and although their movements in courting and combat are more directly the expression of health and vigor, it is surely not willingly on this account that the female exercises her choice. These movements must appeal to her simply on æsthetic grounds. They are directly felt to be pleasing and attractive. Even among mankind the countless impressions with which we are surrounded, crowded with meaning as they are, are nevertheless much more frequently taken simply for themselves than for the meaning which lies behind them. That we are pleased by a certain act is sufficient. It is only rarely that we desire to know its full significance. No doubt that in the operation of natural selection, mankind, as well as the animals, attach the greatest importance to events which are significant of others directly bearing on their welfare. But this significance is felt and acted upon long before it is measured. There even comes to be a sense of significance when that significance remains unknown, a repulsion, or a delight, in that which seems to have some deep and everlasting meaning, and which doubtless has it, however distant it may be from the consciousness of the individual at the time. The countless manifestations of beauty may very readily be signs of something more, but there is no evidence which shows that, with the exception of man, these are ever valued in such a way. The process of nature is much more simple, and rests upon sensuous perception, and the feeling of attraction or dislike arising directly from it. According to this view, however, the appreciation of the beautiful and the reality which lies behind it go hand in hand. "What, indeed, is beauty," says Espinas, "if it is not organization become sensible, life become manifest?"

In the appreciation of the beautiful as thus understood, we must not suppose that the female alone is interested and that the male confines himself to its production, and to the effect of this upon the female. The males are exceedingly sensitive, perhaps more so than the females, to the prowess of other males. The young cocks of many grouse keep at a distance when they hear an older and stronger cock. The young nightingales are not able to sing well the first season, and

gradually learn the accomplishment from the older birds. The males of passerine birds arrive at the nesting places often days in advance of the females, but sing, nevertheless, with great zeal. With the gallinaceæ, generally the singing and display are carried on among the cocks themselves, and when the females are at a distance. This display, as we have already suggested, probably has the effect of daunting other birds as well as warming up individual courage. A slight increase of color or size of feather, or more energetic movements, would be very easily associated with a sense of mastery, and the animal who appreciates this more readily saves himself from defeat, and possibly finds another mate, by whom he sends down his greater sensitiveness to the next generation. He has at least a second chance in the struggle for a mate.

It seems, then, quite possible that selection among the males themselves may lead to an increase of beauty, and even to the appreciation of it on their part. That this beauty is feared rather than loved is at least nothing against its power of fascination, and its really being recognized as beautiful. The charm that serpents exercise on some birds, and the possibility of charming snakes themselves, show the capacity of this kind of fatal fascination. Early races were in the habit of wearing, not ugly, but often beautiful things, for the purpose of striking terror into the hearts of their enemies. The nodding plumes of the Greeks and even the military costumes of the present time are cases in point.

But whatever the agencies at work, the primary relation is clear. The sexual instinct in its irradiation upward and through its increasing dominion over the higher senses and the brain, has given rise to a distinctly æsthetic capacity, capable of appreciating the beauty of form, color, movement, and sound, issuing in whatever way from the bosom of life and expressive of its sweetest harmonies as well as of its depth and power.

Courting Instinct in the Lower Races. The study of the sexual instinct in early man is somewhat difficult of approach. We are cut off from any direct observation, and the historical remains of even the oldest races do not begin to go back to the savage state. The study of the lower races of the present time is certainly instructive, but one is liable to be misled by the fact that these races do not stand in the line of progress, and in some cases are distinctly degenerate types. The light thrown upon early times by archæological remains and by the survival and transmission of ancient rites and customs, reveals an abundance of material suggestive indeed, but

equally difficult to interpret. Between the highest of the apes and our earliest knowledge of man there lies a gap, no wider perhaps than between many other species, but in which we have a more than ordinary interest. As to sexual characteristics, there have come in some important modifications. The periodic breeding season, with the exception of slight traces, has disappeared, and sexual union is possible throughout the year. This physiological fact has decreased the periodic intensity of the sexual passion and placed it more under the control of the higher intellectual and emotional powers. That domestic confinement has the same effect on the apes and on some of the lower animals shows this to be connected, probably in a reciprocal manner, with the advancing social condition. The same thing is shown by the statistics of births, where the increase of conceptions in April and May is found to be greater in the country than in the city.[1] The more secondary sexual characteristics have also changed considerably. The difference between man and woman is said to be greater than between the sexes of most of the quadrumana. In the later maturity of the male, his greater size, larger brain (absolutely) and greater sensitiveness, strength and courage, stronger voice, greater prominence of the superciliary ridge, and sometimes of the sagittal crest, greater hairiness and better developed beard—generally of a lighter tint than the rest of the hair,—man differs from woman in the same way that the male of the quadrumana differs from the female. The secondary sexual characteristics vary greatly with different races. Flat and hooked noses, broad and long faces, high, receding, or broad foreheads, well rounded occiputs, black, red, yellow, and white skins, long or abundant hair, or none at all, leanness, fatness, squinting eyes, enormous ears, protruding buttocks, and breasts long enough to throw over the shoulder, are natural features found in various quarters of the globe, and where they exist are esteemed as beautiful, are preserved by sexual selection, and often enhanced by artificial means.

The courting of the lower races has in it, to our eyes, very little of either love or beauty, but it is very different to the savages themselves. Their rude dances, their tattooing, their ornaments, the display of their persons and their clothing are to them a matter of much importance.

Most savage men[2] take pride in the hair of the head. Now it is painted in a showy manner, now decorated with beads and tinsel, now combed and arranged with the most exquisite care. The Kandhs have their hair, which is worn very long, drawn forward

[1] Westermarck, "Human Marriage," p. 69.
[2] Westermarck, *op. cit.*

and rolled up till it looks like a horn projecting from between the eyes. Around this it is their delight to wear a piece of red cloth, and they insert the feathers of favorite birds, as also a pipe, comb, etc. The men of Tana of the New Hebrides wear their hair twelve and eighteen inches long, and have it divided into some 600 or 700 little locks or tresses, and among the Satuka a man requires a period of from eight to ten years to perfect his coiffure. Tuckey states that on the Congo both men and women shave the head in ornamental figures.

Among the Set-htas in Indo-China it is the unmarried youths that are profusely bedecked with red and white bead necklaces, wild boar tusks, brass armlets, and a broad band of black braid below the knee. Speaking of the Encounter Bay tribe of South Australia, the Rev. A. Meyer says "that the plucking out of the beard and anointing with grease and ochre (which belong to the initiatory ceremony) the men may continue, if they please, till about forty years of age, for they consider it ornamental, and fancy that it makes them look younger and gives them an importance in the eyes of the women." "In Fiji," says Wm. Anderson, "the men who like to attract the attention of the opposite sex don their best plumage, and when Wm. Bulmer once asked an Australian native why he wore his adornments, the native answered that he wore them in order to look well and to make himself agreeable to the women."

But although these outward adornments, in the lowest races at least, are probably more frequent with the men, it is not long before the women are equally anxious to add to their natural charms. Bancroft tells us that young Kadiah wives "secure the affectionate admiration of their husbands by tattooing the breast and adorning the face with black lines," and in another place that the Nahua women used paint freely to beautify their persons. "Among the Aztecs, they painted their faces with red, yellow or black color." They also dyed their feet black. Hands, neck and breast were painted, and their teeth were cleaned and painted with cochineal. The Nahuas also had a passion for loading themselves with ornaments, the more valuable being legally restricted to the better classes of society.

"Among the Makalolo the upper lip is perforated and a large metal and bamboo ring called a pelelé is worn in the hole. This caused the lip, in one case, to project two inches beyond the tip of the nose, and when the lady smiled the contraction of the muscles elevated it over the eyes. 'Why do the women wear these things?' the venerable chief Chinsurdi was asked. Evidently surprised at such a stupid question, he replied, 'For beauty! They are the only beautiful thing women have; men have beards, women have none. What kind of a person would she be without the pelelé? She would not be a woman at all with a mouth like a man, but no beard.'"[1]

[1]Livingstone quoted by Darwin.

It would go beyond our space to describe the different methods savage races have adopted in order to beautify their persons. Teeth are knocked out or filed like saws, the head is shaved, hairs plucked out, eyebrows shaved and eyelashes pulled out, the skull is compressed, feet are squeezed and lengthened, or shortened by doubling up the four smaller toes, ears, noses, lips are loaded with rings and daggers, ear-lobes are dragged down until they approach the shoulder, breasts are cut off or made to project unnaturally, warts, scars and ridges are raised upon the skin, which is also painted, dyed or tattooed. Modifications of the sexual organs themselves are frequent and remarkably persistent among the habits of the tribe. Common practices are those of infibulation and circumcision. The nymphæ and clitoris are lengthened, the glans penis is pierced by needles and provided with ampullæ, artificial hypospadias are produced,[1] the penis is split or covered with hairs, prickles or other instruments. There seems, indeed, to be no part of the body free from some attempt at improvement.

Tattooing, which generally takes place at puberty, is a very chosen form of mutilation, and sometimes gives rise to a quaintness or beauty of design pleasing to any eye.

In Samoa, until a young man is tattooed he could not think of marriage, but as soon as this was done he considered himself entitled to all the privileges of mature years. "When it is all over," says Mr. Pritchard, "and the youth thoroughly healed, a grand dance is got up on the first available pretext to display the tattooing, when the admiration of the fair sex is unsparingly bestowed. And this is the great reward, long and anxiously looked forward to by the youths, as they smart under the hands of the matai * * *." When Merteus asked the natives of Sukunor what was the meaning of tattooing, one of them answered, "It has the same object as your clothes—that is, to please the women." Bock remarks, as the Wyak women are tattooed to please their lovers, so the Laos men undergo the ordeal for the sake of the women.[2]

Ploss states that tattooing around the middle of the body comes in earlier in the history of some tribes than tattooing of other parts. The women of the Ponapé and the Tahiti islands tattoo themselves especially in the neighborhood of the vulva. After this come the breasts, the abdomen and the extremities.[3] That tattooing is used for the purpose of sexual attraction there seems to be no room for doubt, but that it originated in this way is not so commonly conceded. Wundt, Gerland, Frazer and others believe that religious ideas or totemism is the original source, others think that

[1] An operation Remondino suggests for civilization.
[2] Westermarck, *op. cit.*
[3] Ploss, "Das Weib."

it is done to render the person operated upon terrible or invincible in battle. Ploss is of the opinion that it is due to modesty. Some of these causes, however, are not at all remote from the sexual instinct. Modesty, if it is really present, is distinctly a sexual attraction, especially on the part of women, while success in battle is no less so on the part of men. With many races a man is not permitted to marry, nor would he be accepted by the women, until he has killed a certain number of enemies. War is very rarely undertaken for the sake of food or territory; the possession of women is the constant source of conflict between the tribes. Nothing could be more natural or more attractive to the fair sex than tattooing, which would represent their lover's prowess as well as please in a merely decorative way. It becomes a sign of a man's ability to protect his wife and family—to render their love secure, and must, therefore, be a powerful auxiliary in successful courting. The very same signs would have an equally daunting effect in battle. His opponents would fear to stand up to a man bearing such evidences of success. It is not wonderful, then, that tattooing would be found to make the warrior invincible, and might easily come to be resorted to even when not representative of former courage and address.

But although some such mental representations are very probable, yet there is no reason to suppose that beautiful, terrible or significant signs or objects do not also have a direct instinctive effect. After the preliminary displays, brandishing of weapons, boasting, vaunting and cursing, calling upon their gods and despising those of their opponents, have been duly gone through, and the enemy thus given plenty of opportunity to reflect, the more fundamental, and at the same time instinctive, part of the business still remains. In the heat of the conflict, with its necessity for rapid, energetic action, the older, more hereditary instincts have full play, and here, as with the lower animals, the beautiful and the terrible approach each other. The brightest colors, the most gorgeous banners and the most brilliant music have always had an exhilarating effect upon warriors and soldiers of every time, and no doubt an equally depressing one upon their enemies.

Among the lower races, too, the women follow their husbands and lovers to battle, their cries ring in the contestants' ears and incite them to their bravest deeds. After the battle the women become the prize of the conquerors, and sexual gratification, while the participants are still under the influence of the fight, in most instances ensues immediately. Frequently, especially with the lowest races, the women are

not unwilling captives, and would not leave their masters if they could. Victory has had upon them all the effects of a most successful courtship. In cases like these there must be an instinctive association of anything striking, or terrible, or beautiful with both the fear and passion of the fight as well as its culmination in sexual contact.

The connection of tattooing with totemism and religion may no doubt be found. But what is the position which religion occupies among the lower races? Does it not represent a residue of old experiences, a vapor which has arisen from the past, and, like the ozone of the sea or the miasma of a swamp, still penetrates the present with its influence? The heroes of one period, do they not become the gods of the next? The rites and ceremonies, the doctrines of to-day, are they not the memories of living thoughts and deeds of days gone by? To say that religious ideas are the source of any custom is only to refer one to the past, where the problem begins all over again. Not that religion may not sanctify, keep alive and modify a custom, and that at a given period the only reason known for a certain act is that it is religious, but that religion does not begin as something formal and arbitrary, but roots itself on deep biological tendencies, on thoughts and images, instincts and passions, whose neural paths are already a highway for physical and mental activities. It seems much more probable that tattooing began as a sexual attraction, when we already find so many instances of it, and that it afterwards became attached to religion, purified to an extent, and brought into contact with a wider circle of associations.

Even when religious, it does not always, if ever, lose its sexual significance. The Tahitians have a tale that tattooing was invented by the two sons of their god Taaro when they wished to seduce their sister. These two sons became the gods of tattooing. "Their images were kept in the temples of those who practiced the art professionally, and every application of their skill was preceded by a prayer addressed to them, that the operation might not occasion death, that the wounds might soon heal, that the figures might be handsome, attract admirers, and answer the ends of wickedness designed."[1]

The tattooing found so frequently on the bodies of criminals of the present day is not generally so beautiful as that of the savage races, although the connection with sex is sufficiently close.[2] There is not the same sensitiveness shown

[1] Ellis.

[2] Cf. Laurent, "Les Habituées des Prisons de Paris."

in the suitability of the design to the place it is intended to occupy. The lines are not, as in much of savage tattooing, made to follow the surface of the body. It has lost its decorative character and become more purely representative. In this it reflects the higher development of art and the advancement of civilization, but only in a formal way. The ideas which have led to this advancement and are contained in it are here entirely absent. Moreover, there is no reason why the most representative graphic art should not also be quite satisfactory from a decorative standpoint. The masterpieces of modern art have found a way to satisfy both demands. But the tattooing of criminals is not an art as was that of the savage races. It is lacking in appeal to the beautiful, nor is it either terrible, expressive, or even comical.

Clothing. From tattooing to clothing is an easy step. As Professor Mosely says:

> A savage begins by painting or tattooing himself for ornament. Then he adopts a movable appendage, which he hangs on his body and on which he puts the ornamentation which he formerly marked more or less indelibly on his skin.

The variety of material used for clothing indicates the activity of the fancy and the desire for decoration. A simple shell, a string of beads or shells, a thin fringe of fibres or leaves, empty egg-shells, or even a thread tied round the middle or under the arms, often forms the whole dress, which is frequently only adopted at maturity, or worn upon special occasions.[1]

> Tasmanian dances were performed with the avowed intentions of exciting the passions of the men, in whose presence one young woman had the dance to herself. During these dances the women wore a covering of leaves or feathers, which was removed directly afterwards.[2]

From a large number of similar cases Westermarck concludes that the feeling of shame is not the origin of the adoption of clothes, but that in many cases, at least, "men and women covered themselves to make themselves more attractive—the men to the women, and the women to the men." When all go perfectly nude, he says, "nakedness must appear quite natural, for what we see day after day makes no special impression upon us. But when one or another—whether man or woman—began to put on a bright colored fringe, some gaudy feathers, a string with beads, a bundle of leaves, a

[1] West of Tanganyika the people go naked, but by a manipulation of the fatty tegument of the lower body in childhood, they produce an apron which hangs down almost to the middle of the thighs. (Schurtz, "Philosophie der Tracht," p. 21.)

[2] Westermarck, "Human Marriage."

piece of cloth, or a dazzling shell, this could not of course escape the attention of others: and the scanty covering was found to act as the most powerful obtainable sexual stimulus. Hence the popularity of such garments in the savage world."

These facts undoubtedly show the closest connection between clothing and the attraction of the sexes as Westermarck points out, but it is not to be understood by this that clothing itself is, normally, a direct appeal to passion. Simply to attract attention to the sexual organs can, surely, not be the whole of the purpose. For this, a gesture, the mere exhibition of the body, the simplest expression of desire, would be much more effective. The brilliant colors, the odd and curious forms of primeval dress and ornament, must have the effect of awakening mental processes which intervene and tend to postpone the sexual climax. They must represent a margin, an overflow, which engages the attention with something else than immediate gratification. The primary effect will be to momentarily withdraw the sexual impulse when that is present, and to allow of an irradiation where the mind is engaged with visual sensations not primarily the sign of sex. That the wearing of bright objects is believed to have the effect of warding off danger, is shown in their use to avert the evil eye, which is often only a synonym for an uncontrollable sexual passion. By the use of such objects the attention is directed rather to the personality than to the person, which is always sufficiently plain. It is an attempt to display psychical rather than physical features. The bit of ornament is an expression of an inner state, of a sensitiveness higher than the crude though powerful sensations of sex, and it is for this reason that it becomes at last an attraction and may be preserved by sexual selection. Ornamental clothing is not a simple lure. It is a sign or symbol of a greater refinement of perception and delicacy of feeling, and the man or the woman who gives the best evidence of these qualities is the one who is chosen by members of the opposite sex who possess such qualities themselves. The attraction is in the mind and not in the sexual organs.

But if higher considerations do not inhibit its activity (and here also we see the value of a margin), and the sexual instinct is to obtain its culminating satisfaction, the wider irradiation by spreading an erethism throughout the higher centres of the brain, will, by its reaction on the system, only aid in arousing and strengthening the natural performance of the sexual function. The objects of beauty may then very readily under the influence of passion at white heat become identified with its pleasure and satisfaction, and apart from the representative effect of which we have already spoken

become instinctively connected with purely sexual feelings. When, however, this instinctive connection leads the rest, the sexual instinct has lost its highest potentiality, has retreated and fallen back upon its centre, and although it may be more concentrated and rank, is also more easily defeated in the struggle for existence. This difference between a symbolism which is alive and growing and one which is only instinctive, is the difference between art on the one hand and a degraded fetichism on the other.

Shame, Jealousy, and Fear. Let us now turn to another phase of the question of clothing, where we find a symbolism more of a moral than an artistic nature. Jealousy, as we have already seen, is very frequently an underlying feature of the passion of sex, and far from being sloughed off with advancing development, has gradually shown itself more plainly in the higher species. The institution of marriage, both in man and in the higher animals, especially in the quadrumana, is largely ascribable to its influence. Schurtz[1] is of the opinion that the feeling of shame in the human species is connected with jealousy and an outcome of social development. The desire of the man for complete possession has given rise in the woman to a desire to conceal and protect what is regarded as valuable. He gives instances which indicate that people who are habitually naked, yet show the effect of shame, and occasionally hide the sexual organs. He states that in the most of cases, and the exceptions are those of the lowest races, it is the women who are more carefully covered, and he thinks that the use of clothes which begins with the sexual organs is the "outer expression of a specific human morality." He points out that it is the married women who are the most frequently and most completely clothed. That the dress, however scanty, is the recognition of this condition, and the sign of its approval by the tribe, an indication of the fact that the wife belongs to one man; "that for other men she exists no longer as a woman, but only as a human being." Schurtz mentions as other possible sources of the use of clothes, the need of protection from weather, flies, and small injuries, the desire for ornament and decoration, and the desire to distinguish classes or individuals, by way of trophy or princely signs. He regards the æsthetic ground as the least probable of any of these sources, and says that the sculptor, who knows much more than these uncivilized people of the tropics what beauty means, does not cover up the naked body, but unsuspiciously reveals it—that he would find it the greatest prudery to be untrue to nature, and that we never find the

[1] "Die Philosophie der Tracht," p. 17.

purely natural ugly, so long as influences from other sources do not work upon our feelings, *i. e.*, that there shall be no sexual stimulus. When, later on, he speaks of clothes in art and particularly in sculpture, he says that the figure here does not come under the same laws as in reality, that in art, clothes may be used as an ornament or as a means of expression, but not as a covering. He also admits that although clothes are originally used as covering, and therefore more by the women than the men, it is just with the women that, later on, they become more highly decorated and serve as a means of attraction.

The weakness of this theory lies in the fact that it does not account for the wearing of clothes by men, and if the lowest races represent the earliest stages, it would appear, according to Schurtz's own admission, that men began to use clothes first. But as to the priority of their possible origin, we are not for our purposes particularly interested. Whichever is first, all of them are actually found as causes for the use of clothes. The mere starting point, a very difficult thing to determine, is of much less consequence than the natural trend of the associations. It may very possibly be that different tribes originally used dress for different reasons, but the question is, having adopted it, do they not lay great stress upon it as a means of beautifying themselves, rendering themselves attractive or producing an impression of value and importance, especially conducive to success in love? The feeling of shame itself, with its derivatives, modesty on the one hand, coquetry on the other, is undoubtedly a great attraction, tending to satisfy and allay the jealousy which underlies the sexual passion.

From a consideration of the facts it seems reasonable to take the view that men and women adopted dress for different motives—the man originally for the purpose of decoration and attraction, the woman for the purpose of a covering. In this the sexes are true to the characteristics they have shown throughout the animal series. The feeling of shame is not originally a male quality, nor deeply rooted in the sexual instinct regarded by itself. It is related rather to fear and an outcome of self-preservation, conservative in its tendencies, and characteristic of the female diathesis. This does not prevent its having been selected by the males as a result of their rivalry and jealousy of each other, nor its transmission by heredity to the males themselves. It is clear that like the other foils of the sexual passion, shame must be overcome by love before the culmination of the final act. The jealousy on the part of the man, the fear to offend this on the part of the woman, of which the concealment of the person

may be an expression, would have no meaning but for the sexual instinct, and the possible gratification thereof which has called them forth. No doubt the feeling of shame is a specific human morality, but it has its origin in sex. It is made to be overcome, and the acts of display, of attraction and ornament, which tend to affect this purpose must be a deeper and more fundamental expression of the sexual instinct, which however only shows its strength and range as it becomes more widely irradiated. As Mantegazza says:

> The more one simplifies love and reduces it simply to a connection between two persons of opposite sex, so much the less easy is the development of jealousy and the less complicated is the sensuous ceremonial. The more it is surrounded by the feelings of shame, coyness, secrecy, and obscure and undefined ideas, the more full of sensation and tenderness becomes the whole mechanism, but also the more easily broken.[1]

The moral and the æsthetic values of clothing are thus not really opposed. Both, as irradiations of sex, increase each other's effect. The delicate and even severe morality of the present day in matters of dress, probably tends to accent, if it makes more rare the æsthetic sensibility, as well as the keenness of the sexual feeling from which it is derived.

Symbolism and Fetichism. In their estimation of what is beautiful and attractive, savage races are greatly influenced by the smallest and finest distinctions. Of the thousands of possible beauties which such an organic structure as the body might present, they pick out one or two to which they pay attention, while they neglect the rest. A view which is able to grasp the harmony of the whole and knit together the greatest variety of detail seems impossible to them. One tribe will insist upon some few characteristics which it sets up for admiration, while an adjoining tribe, with almost the same material to work upon, picks out characteristics and originates manners and customs entirely different. It seems as if, at all costs there must be emphasis, there must be a focus, whether that is situated so that its penumbra takes in the greatest possible remaining beauty or not.

The religious spirit is equally close and narrow. A stick or a stone which differs but unimportantly from many another, is seized upon, its differences magnified in the imagination by the very act of attention, and set up for adoration. The turning of a feather will determine an expedition. The doing of a thing at a certain time and in a certain way without the deviation of a hair, and many more such whims, fears and superstitions, present the same psychological features.

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[1] Anthropologish-cultur-historische Studien über de Geschlechtsverhaltnisse des Menschen, p. 39.

This fetichism is of course not absent in the lower animals, but in man it reaches a fineness and discrimination to be found nowhere else. It depends primarily upon an increase of the psychological process of representation, involving greater powers of comparison and analysis as compared with the lower animals. The outer impressions come to be clearly distinguished as such, but at the same time are often treated as symbols of inner experiences, and a meaning read into them which they would not otherwise possess. Symbolism or fetichism is, indeed, just the capacity to see meaning, to emphasize something for the sake of other things which do not appear. In brain terms it indicates an activity of the higher centres, a sort of side-tracking or long-circuiting of the primitive energy. It is not the mere sensuous impression of the crooked stick and the attendant reflexes which have control. This impression has given rise to another process, which for the moment dominates the brain, and under whose influence it actually neglects what is more immediate and apparently more real. The stick itself becomes the symbol for this peculiar and otherwise expressionless experience, and it is set up as a fetich or a god. Once having obtained this focusing power, the advancement of humanity is determined by ever-increasing improvements in its adjustment and its range.

As already stated, it is neither in the absence of sexual excitement nor in the very height of it, that the margin making possible the formation of a fetich or sensuous symbol, occurs. Movements capable of leading up to the climax are more productive in this respect. Particular movements of the dance, particular decorations have their origin here, and tend to become symbolic and fetichistic. J. Donovan,[1] in "Festal Origin of Human Speech," speaks of the absorptive power of sensation under festal excitement. "We must not lose sight of the absorptive elements of sensation, the regular movements of the body, the rhythmic sounds of sticks and stones, the rhythmic and articulated cries. It is, perhaps, impossible to estimate too highly the value of this absorption for enabling the festal excitement to mould the natural passions according to its own tendencies instead of being destroyed by them." Rosetti's poem, "The Woodspurge," gives a concrete example of the formation of such a symbol.

> "The wind flapped loose, the wind was still,
> Shaken out dead from tree and hill;
> I had walked on at the wind's will,—
> I sat now, for the wind was still.

[1] *Mind*, July, 1892.

Between my knees my forehead was,—
My lips, drawn in, said not Alas!
My hair was over in the grass,
My naked ears heard the day pass.

My eyes, wide open, had the run
Of some ten weeds to fix upon:
Among those few, out of the sun,
The woodspurge flowered, three cups in one.

From perfect grief there need not be
Wisdom or even memory:
One thing there learnt remains to me,—
The woodspurge has a cup of three."

Here the otherwise insignificant presentation of the three-cupped woodspurge, representing originally a mere side current of the stream of consciousness, becomes the intellectual symbol or fetich of the whole psychosis forever after.

It seems, indeed, as if the stronger the emotion the more likely will become the formation of an overlying symbolism, which serves to focus and stand in place of something greater than itself; nowhere, at least, is symbolism a more characteristic feature than as an expression of the sexual instinct. The passion of sex, with its immense hereditary background, in early man becomes centered often upon the most trivial and unimportant features, which are often not at all representative of profound biological affinities, such as are without doubt the bright colors, beautiful voices, etc., of the lower animals. The mutilations, the tattooings, the rites of puberty, the dress, the ceremonies so rigidly insisted on as a preliminary to sexual gratification, indicate, however, a psychic advance. This symbolism, now become fetichistic, or symbolic in a bad sense, is at least an exercise of the increasing representative power of man, upon which so much of his advancement has depended, while it also served to express and help to purify his most perennial emotion.

While this is an account of the inception of a symbol or fetich, after this has once been established it is not necessary that there should, especially among the majority, be much if any conscious reference to its significance. Its effect on the sensibility is assured by heredity and social custom. It may even lose its meaning, or become loaded with a meaning much larger than was originally intended, while at the same time it becomes more in harmony with the basal æsthetico-physiological demands of the retina, the ear, or the sense of movement. Plenty of our conventional designs have had just such a history, as well as many of the words and gestures which we unthinkingly or superstitiously use.

Phallicism. The necessity of human nature to focus attention upon something which becomes a sign or symbol of other things more important than itself, played a great part in the early phallic religion. Here was an attempt, immense, profound, to envisage the whole of a scattered experience and give it form.

Phallicism is not a religion characteristic of the very lowest races. In Africa to-day it is strong with the Dahomeyans, among the sturdiest races of the blacks. It lies back of Aryan history. The Bibles of the world imply it, as do much of present rites, ceremonies and sacramental costumes. The legend of the Holy Grail and the noble figure of Sir Galahad have descended from it.

It seems strange that the worship of the generative organs, and particularly of the male organ, should be the natural continuation of that instinct for the beautiful which, as an outcome and irradiation of the sexual passion, we have already observed in operation with man and the lower animals. But no one can understand phallicism who fails to observe how closely interwoven it is with society and the gods. It is no private cult, nor does it depend merely upon free sexual selection and the rivalry of individuals. It is a great idea, able to constrain the hearts of thousands. This is the source of its beauty as well as of its usefulness in the struggle for existence among warlike nations. As a great idea it bound the people together and summed up an immense circle of outward irradiation. Ancestor worship, tree and serpent worship are phases of phallicism. The goat, bull, serpent, tench, turtle, domestic cock, scarabæus, dove, pig, lotus, the constellations, the moon and sun with fire its earthly representative, heat and moisture, pyramidal stones, artificial obelisks and pyramids, uprights generally, from which have probably descended our church steeples, the globe, the cross,[1] and many other forms, as symbols of death and life, generation and regeneration, are interchangeable with the human phallus.

Lajard[2] traces phallicism to its oldest known forms among the Chaldæans. Their philosophy was, in a word, the universality of generation. Everything waxes and wanes. Periodicity is the world-law. Sexuality is its expression and

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[1] Count Goblet d'Alviella ("La Migration des Symboles") takes the view that crosses are cosmogonal, the four arms symbolizing the four directions. As a sign of the weather they would come to be a token of health and good wishes. This is not contradictory to a phallic interpretation. As we shall see, phallicism could not become a religion until it became cosmogonal, and in that sense universal.

[2] "Culte de Venus."

its most important typical phase. The oldest god is male and female in one : the bearded Venus, the heavens and the earth. It was by the division of this mystic hermaphrodite that the sexes were formed and Venus Pandemos became Venus Aphrodite and Hermes or Priapus. The original human being was also bisexual, and afterwards divided by the gods into man and woman. This first state was one of quiescence, symbolized sometimes by the egg, from which everything comes.

By comparing all the varied legends of the east and west, we obtain the following outline of the mythology of the ancients: It recognizes as the primary elements of things two independent principles of the nature of male and female: and these in mystic union, as the soul and body, constitute the Great Hermaphrodite Deity. THE ONE, the universe itself, consisting still of the two separate elements of its composition, modified, though combined in one individual, of which all things are regarded but as parts.[1]

Associated with this bi-sexual philosophy of things, originating contemporaneously, or derived from it, is a trinitarian explanation, which is also essentially phallic in its symbolism and application. When the original unity became divided into powerful separated deities, it still seemed to maintain a certain existence in the minds of believers, first as a general ground of existence and afterwards as an independent personification. The sun in some religions is entirely masculine ; Baal and Molock are characteristic Semitic forms; but in many cases in the sun became concentrated the three persons of the Deity. These were distinguished as the creating, the preserving, and the destroying powers. In Hindostan, Brahma, Vishnu, Siva ; in Persia, Oromasdes, Mithra, Ahriman ; in Egypt, Osiris, Neith, Typhon.[2] These forms are more philosophical and later phases of phallicism, and, although they absorbed the strength of the earlier phases, yet often left them behind to continue their hold upon the imaginations of the lower classes. In case of any conflict it was always open to the leaders to identify their more cultured art and religion with the cruder forms. The worship of Juggernaut, or the great creator, as the word signifies, for example, goes back to the very earliest times. This god is worshipped in the form of a bull, which is identified with Taurus of the zodiac. According to Higgins, Inman,[3] and others, his worship has been carried on from the time that the sun in the vernal equinox was in the first degree of Taurus, 6,600 years ago. After passing through Taurus, the sun appeared in

[1] Corey's "Fragments."
[2] Godfrey Higgins, "Anacalypsis," p. 13.
[3] "Ancient Faiths."

Aries, which also, with its earthly representative, became a phallic sign.

The sacred word, Om, is a symbol of the Hindoo trinity. It is in the original spelled with three letters, and, as Higgins[1] says, it would be better expressed in English by Aum, Aom, or Awm. The first letter stands for the creator, the second for the preserver, and the third for the destroyer. Sir W. Jones says that the mystical word Om signifies the solar fire. In an old Purana we find the following passage: "All the rites ordained in the Vedas, the sacrifices to fire, and all the other solemn purifications shall pass away, but that which shall never pass away is the word Om — for it is the symbol of the Lord of all things." Higgins thinks that this word is found in the Greek *omphi* (an oracle) or *omphalus*, which is related to the Latin, *umbilicus*. It will be remembered that the Hindoo devotees, while repeating their sacred word, sit with crossed legs gazing at the navel. The position is also physiologically in harmony with a half ecstatic abstraction.[2] The word *triomphe*, repeated in the Dionysiac festivals, is *triom-phe*, *i. e.*, the triple *omphe*, although this might be repeated in Greece without any idea of its origin or meaning than that of its being a sacred word. Inman believes that the word John with its synonym Jack are of phallic origin, the first form of John being IO or ION. He identifies the O with the *kteis*, or female organ, I, the upright, with the phallus. The Hindoo word YONI, the emblem of the female organ of generation, is another form of it. Jack is a form of Iacchus or Bacchus, the sun god, and belongs to the male side of the symbolism. Both words were used in the revels of the Eleusinian mysteries, which were descended, as Plutarch suspected, from very ancient times, and were probably survivals of the spring festivals of savage people, in which sexual excitement is such a prominent feature. In Greece and afterwards in Rome, these mysteries became the occasions of the wildest orgies. Maids and matrons ran wildly through the woods, naked or clothed in skins, with serpents in their hair. They carried with them sexual symbols, flourishing torches, which continued to burn when plunged in water. They tore animals to pieces in their fury and ate the flesh raw and quivering. In the festivals in honor of the reproductive powers of nature, held in Rome in the month of April, "the Phallus was carried in a cart and led in procession by the Roman ladies to the temple of Venus outside the

[1] *Op. cit.*, p. 126.

[2] A return to the position of the embryo.

Colline gate, and there presented by them to the sexual parts of the goddess."

With the advent of Christianity these ancient feasts were re-edited and made to speak more purely, if more abstractly, of reproduction and immortality, generation and regeneration. The higher elements of religion and art, the sentiment for nature, and religious adoration characteristic of the spring, would seem to have lost to a very large extent their sexual content; although the intensity of feeling and emotional depth which accompany these higher manifestations, proclaim themselves as the natural transformation of the primitive energy of sex. The preliminary fasting, the repression of the sexual instinct during the time of Lent, the determination of the date by the changes of the moon, a female symbol, besides many popular customs, *e. g.*, the eating of eggs, of hot cross buns, also show how much the new form has been dependent on the old.

The story of the fall is referred to in the history of many different nations, and told in many different ways, which are yet essentially similar to the account given in our own Bible. In many of these cases there is an undoubted phallic reference. According to the Persian legend, "the first man and woman were seduced by Ahriman under the form of a serpent, and they then committed 'in thought, word and action the carnal sin, and thus tainted with original sin all their descendants.'" Wake[1] says "eating the forbidden fruit was simply a figurative mode of expressing the performance of the act necessary to the perpetuation of the human race — an act which in its origin was thought to be the source of all evil." The serpent is continually associated with phallic symbols, and becomes itself a phallic sign. The cobra of India is said to copulate while standing upright in the double twisted form, represented in the Caduceus of Mercury. Wake[2] says that the Phœnicians supposed that the serpent had the quality of putting off its old age and assuming a second youth, connected probably with the casting of its skin, a quality which was made use of in typifying generation and eternity.

This short account of the symbolic side of phallicism will suffice to indicate its great fertility and resource. The symbols we have been dealing with, although they represent the spirit of a past religion, are in themselves forms of art, productions, inventions, which appeal directly to sensibility, whatever other content they may possess. Sculpture, architecture, the graphic arts and poetry in no less degree, were

[1] Westropp and Wake, "Ancient Symbol Worship," p. 39.
[2] *Op. cit.*, p. 45.

the channels through which they flowed and by which they have come down to us. The rites and ceremonies are often but the abbreviated remains of a presentation essentially dramatic. The sacred words are concentrated poems, and are received and felt by devotees with a corresponding ecstasy.

But there is another side of even greater consequence, the emotional and active side, and it was the union of this with an intelligible symbolism that made phallicism what it was. The relationship that exists between these two is very much the same as that which obtains between money and wealth. The formal and intellectual side is of no value apart from the wealth of feeling, emotion, sense of value and worth, which it expresses and renders more easy of manipulation and exchange. The value of symbolism to the sexual instinct lies in its capacity to utter the vast and unknown past that wells up in every man who feels and thinks, and at no time more poignantly than under the influence of love. How, then, did phallicism play upon or express these original and voiceless powers?

In the first place, indistinct and complicated symbolism itself effects the more irradiated portions of the imagination, and favors a filling of reverie, mysticism, and other sensuously tinctured lesser emotions, which lead naturally, in the healthiest natures at least, to the complete vigor of the sexual passion. But there is no place in which phallicism shows its depth and range more distinctly than in the way in which it exploits the associated passions of fear and anger, and through them intensifies the upward recoil of confidence, faith and love. Death is constantly brought face to face with love in its most ecstatic condition. Says Higgins[1] of these early times, "Everywhere throughout all nature the law that destruction was reproduction appeared to prevail," and that this (a very suggestive point) led as its natural outcome to the belief in the transmigration of souls. The worship of the serpent was particularly characterized by these cruel and terrible excitements.

The representations of Kali, the goddess of nature and fecundity, may be taken as an example:

> She is entwined with serpents; a circlet of flowers surrounds her head; a necklace of skulls; a girdle of dissevered human hands; tigers crouching at her feet,—indeed every combination of the horrible and loathsome is invoked to portray the dark character which she represents. She delights in human sacrifices, and the ritual prescribes that previous to the death of the victim, she should be invoked as follows: "Let the sacrificer first repeat the name of Kali thrice, Hail Kali! Kali! Hail Devi! Hail, Goddess of

[1] Anacalypsis.

Thunder! Iron-sceptered, hail, fierce Kali! Cut, slay, destroy! Bind, secure! Cut with the axe, drink blood, slay, destroy!" "She has four hands," says Patterson, "two of which are employed in the work of death ; one points downwards allusive to the destruction, which surrounds her, and the other upwards, which seems to promise the regeneration of nature by a new creation."[1]

Conversely, it is to be noted that the æsthetico-sexual erethisms are perhaps the only producers of devotion and sacrifice, which still, as in phallic times, imply a reference to death. Sacrifice for religion is still possible, and there are yet students of beauty who starve on a crust for the sake of art.

Phallicism in the minds of these early people had in it nothing indecent. As Payne Knight says, the act of generation was considered as a solemn sacrament in honor of the Creator. In some countries it was performed by the priest or prince before the assembly of the people. The virgins participating in the act were highly honored. Many, in fact most, of the ancient temples and surroundings were favorite places for sexual congress. When the gods allowed the birds this privilege within the sacred precincts, it was thought the act could not be displeasing to them. Accordingly doves were often associated with the temple worship. In these temples troops of women were kept for the purpose of ministering to the sexual needs of the devotees. They were often the most beautiful and the most highly honored in the land, and a great distinction was made between them and the prostitutes who sold their bodies for their own gain. The children of these unions were brought up in thetemple and the best of them were used in its service.

Dulaure says that these customs overcame the excessive rancor of war between different peoples, (strangers being frequently favored) and that they made the nation more numerous in a time when numbers were of the greatest importance.

Despite its cruelties, phallicism was essentially a religion of reverence and love. Ancestor worship and the love of fatherland which springs from it have their roots in phallicism. The Greek Lares and Penates were the rude representations of male and female organs of departed ancestors. They were placed over the fire-place, because fire represented the sexual flame or life, "the engenderer of the heavens and the earth."[2]

Even the serpent himself, the most venomous and deadly of beasts, gets tamed beneath its influence, and becomes the symbol for wisdom and healing.

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[1] "Ophiolatreia."

[2] Cf. Jennings, "Phallicism," p. 286, and Forlong's "Rivers of Life."

The crucified (brazen) serpent, adored for its healing powers, stood untouched in the temple, until it was removed and destroyed by Hezekiah. . . .The sacred snake of Athens had its abode in the Acropolis, and her olive trees secured for her the victory in her rivalry with Poseidon. The health-giving serpent lay at the feet of Asklepias, and snakes were fed in his temple at Epidauros and elsewhere.

The old terror worship tended to die out, and it is in the higher forms of religion that we find the serpent lingering longest as a symbol of beneficence. It still remains with us as one of the insignia of the medical profession, and in the marriage ring. As with other forms of art the tendency has been to eliminate the less permanent pleasure-giving features, which become less and less in harmony with a higher civilization.[1] It is not darkness, snakes, and gore, that are the objects of fear to the modern man, and against which his courage may rise to intoxication. His terrors are more intangible and on a higher psychical plane. The vast irradiations of society and the difficulty of finding one's niche, the fear of insanity and disease, and of the incalculable effects of heredity, of losing one's grip, the dread of the slightest jar in the ideal harmony of two loving souls, the immense weariness in presence of that strange destiny of the universe in whose presence the best effort seems wasted,—these are the weird terrors, typical of the modern man, and before which both generating and regenerating love are too often overthrown.

Modern Phallicism. The question naturally arises, has phallicism any message for the present times? No vital religion has neglected the sexual nature, of which with all the "jenseits" it is originally an irradiation. It is only in periods of weakness and decadence that these extremes become opposed or dissociated. In this respect it is to be doubted if modern civilization has succeeded in increasing the advantages of a stimulating and purifying solidarity inherited from the past. Early Christianity was not nearly so negligent. Its combat with preceding religions forced it to take practical cognizance of the rankness that underlies all nature, and it was not for many centuries that the attitude of the church became purely negative and ascetic, nor until Puritan times that these qualities became the possession of the people.

A return to phallicism, as we see it historically, would be like modern tattooing, an art of criminals, which could never be the equivalent of the original vital thing itself. The same instincts, however, still exist, and if unhandled by the natural leaders of society, become atavistic and reactionary. The

[1] Cf. Marshall, "Pain, Pleasure and Æsthetics."

Puritan repression is too self-centered. The purity that does nothing more than keep itself unspotted from the world, is unsuited to our growing wants and larger social consciousness. What we need at present is a modern phallicism, a religious and artistic spirit that goes out to meet the sexual instinct, and is able to find in it the centre of evolution, the heart and soul of the world, the holy of holies to all right feeling men. We need the manly courage and noble love which are able to protect and to enshrine the beautiful body and soul of woman, able to be faithful in the perilous days of youth to her dear image, shining yet as through a glass, but darkly, a fidelity able to keep this dim and evanescent imagination like a charm against coarse seductions. This ideal we need to base upon the facts of biology and history. No abstract dream will stand the strain of our present knowledge of the world, nor the intimate experiences of married life. This *joi de vivre*, like all the irradiations of sex, must be an outcome and an overflow of our present actual circumstance.

Some of our best literature shows a dawning of this idea. Goethe's Faust is strongly sexual. The witches' kitchen in which Faust drinks the rejuvenating draught which enables him to see a Helena in every woman that he meets, is typical according to Goethe's admission in conversation, of the influence of sex. The outcome of the whole drama might be summed up in the words—to adopt Bayard's translation: "Ever the womanly lifts, leads us on." The French poets are admittedly sexual, sometimes atavistically so. De Musset boasts in one of his lyrics of having sung "*la rouerie*" to the young men of France. Swinburne in a much more pessimistic way had at one period a similar tendency. Tennyson appeals with appropriate delicacy to the tenderest of sentiments. Of 120 poems in a volume of selections of Browning, sixty-three are sexual in subject.

But it is not necessary that art should deal with this problem in so many words. Passion is better touched by an unseen hand. Suggestiveness that reaches to the subconscious regions is deepest of all. So we find many poems and other art works, which without a word of sex are simply embodiments of its movement, and have a similar effect upon the feelings. The very essence of everything lyric in poetry, paint, or music, is the heart-bursting overflow of love, and it strangely follows even in its form, the play of the successive moments of a sexual passion. When a poet sings as the bird sings because he must, like the bird, he can not fail to embody the erethic qualities of sex. That he may be unconscious of the biological source of his enthusiasm, is at

least no argument against its existence. Browning in his "Women and Roses" gives us an example of what is meant. The first five stanzas follow an emotional crescendo, which is filled with beautiful, vague and mystic images, and overflowing with tender words. The fifth stanza breaks through all reserve:

> "Deep as drops from a statue's plinth,
> The bee sucked in by the hyacinth,
> So will I bury me while burning,
> Quench like him at a plunge my yearning;
> Eyes in your eyes, lips on your lips!
> Fold me fast where the cincture slips,
> Prison all my soul in eternities of pleasure,
> Girdle me for once! But no—the old measure,
> They circle their rose on my rose-tree."

In the following and closing stanzas, Browning irradiates the passion and carries it upwards to the stars. The effect here is of course dependent on the matter as well as upon the form, and is so clear that it seems as if Browning must have been distinctly conscious of the principle.

Many technical forms, *e. g.*, that of the sonnet, with its slow and measured octette, its more rapid, impassioned, and variable sextette, show a similar spirit, as does the movement of many musical compositions, even when the musical content is not directly amorous. Although it is not so transparent to the most of observers, the aim of painting is also lyrical. The joy of the artist in his work, and the embodiment of that joy in his productions, is the largest factor in successful painting. The go, the snap, or the larger and steadier enthusiasm which takes longer to appreciate, is all upon the canvas for every one to read. The mere portrayal of objects, mere drawing, is the crudest thing a painter has to do; color and the mystery of tone, so thoroughly dependent on health and mood, are the essence of his activity. Brush-work, instead of being an art for artists, becomes the most intimate expression of life within the painter's grasp, and is, as may be supposed, the last and most difficult art to be attained, without sacrificing more fundamental and basal qualities. In this respect, the aim of painting, as some one has said, is to express everything with two dots and a dash. It is here that the first weariness is detected, so destructive to all art work. A recent painter is said to have practiced for several months till he could express the wet rim of a cart-wheel, reflecting sky and trees, and quite of a character of its own in form and

texture, by one large sweep of his brush—a *tour de force* which is not lost upon the sympathetic observer.[1]

With the assumption of the reflex arc as the unit at the basis of our psychic life, it is not difficult to state these interrelationships of art and sex in physiological terms. Let us suppose *srm* to represent such an arc, in which *sr*, *sr* are two afferent nerves; *r*, the reservoir of energy or nerve cell, and *rm*, the efferent nerve leading to the muscle *m*. In order to make the diagram as graphic as possible, I have represented the reservoir *r* with a curved outlet of large capacity, capable of being emptied only when *r* is filled, and, in the present state of neurology, it will do little harm if the arrangement is pictured somewhat after the manner of a hydraulic siphon apparatus, which is filled from *s*, *s* and emptied at *m*. To carry the comparison farther, if we suppose that there is a certain amount of evaporation or leakage from *r*, we shall have an illustration of the failure of a repeated stimulus to produce a reaction when the time elapsed has been too long. The emptiness of the reservoir will represent fatigue, and a soakage inwards will stand for the effects of nutrition. The narrow channels, *sr*, *sr*, forcing water into *r*, will represent the effect of a stimulus. This will then represent what occurs with the primitive sexual as well as with any other form of simple reflex. If *r* is already well nourished, or in a full, almost overflowing condition, it will take very little stimulus from *s* to fill it up to the point of discharge. If the stimulus is slight or the cell comparatively exhausted, it must be repeated at short intervals or with increased intensity to produce the same effect.

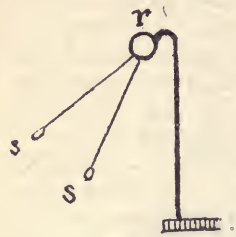

FIG. 1.

Further important characteristics of nervous reactions imply the development of a system and the addition of other connected cells (possibly by induction, as the work of Golgi

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[1]It is interesting to observe the way in which the modern novel (which is to be regarded as essentially a form of the drama) provides the associational frame-work for the sexual passion. The more vulgar and most salable forms pass quickly on the most insufficient pretext, judged from a realistic standpoint, from one phase to another of passionate declamation, interlarded frequently with descriptions of terrible accidents, of plots, murders and other scenes which play upon the auxiliary emotions of fear and anger. The better class of novels in attempting a deeper analysis of life still appeal to the passion of love, even when that subject itself is ostensibly omitted.

and Cajal would indicate). In the diagram (Fig. 2) another motor cell of less capacity, but with more highly differentiated, less somatic sensory avenues, is united to the first by a fibrous connection. In the language of our comparison, another reservoir has been added. It will now be more difficult to fill r from the direction of s, s at least, as there is a completely developed leakage to r^1, but when both reservoirs are filled and both discharged, the effect will be greater, representing more muscular and glandular elements brought into play. If the influx to r is rapid, it will be capable of being discharged alone and before r^1 is filled (owing to the small capacity of the fibrous connection), but the discharge will not be so copious nor the results so effectual as if r^1 had been used. Moreover, if r^1 is not brought into play it will leak back into r, and there will be another discharge sooner, and, if r is stimulated rapidly again, weaker than if r^1 had been properly fatigued. This will represent the relationship between the fundamental sexual functions, erection, discharge of glands, etc. (r), and the more irradiated parts of the system (r^1) when copulation is the aim in view. The ideal curve of the whole activity will be slow and high and consequently of infrequent occurrence. It will rise gradually and fall rapidly, while the partial activity will be rapid and more frequent. The curve a, Fig. 3, will represent the first, b the second. The irradiated portions (r^1), however, are not always used in the interest of sex. The cell r^1 is capable of being stimulated by its own sensory avenues (s^1, s^1, s^1), and, if this is rapid and frequent, discharge of r^1 may occur without leakage to r. In such circumstances the overflow of r will fill up r^1 and increase its capacity to discharge, while its own action is thereby postponed or inhibited. These two reaction systems represent the relationship of sex and art. In a highly developed system, however, this relationship is mediated by countless possibilities of reaction or motor cells. The secondary sensory apparatus becomes highly developed, particularly in the eye and

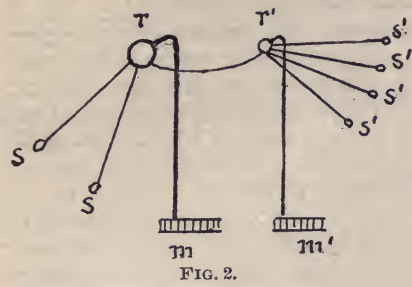

FIG. 2.

s, s^1, sensory end organs.
m, m^1, muscles or glands.
r, r^1, reservoirs of energy or nerve cells.
sr, s^1, r^1, afferent nerves.
rm, r^1, m^1, efferent nerves.

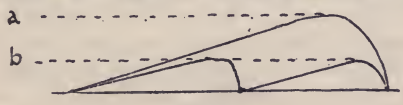

FIG. 3.

ear. With the development of the brain, an association system becomes possible and the sensuous phantasy comes to take its place as the most irradiated portion of the psyche, not excluding even the primary sensations of the eye and ear. The accompanying diagram will show a way in which this radiation may be supposed to have been carried out. The action of r^1, r^2, etc., represents the form of action, which is characteristic of all the senses which bring us in contact with the outer world. It is quick and recovers easily. Normally, the eye and ear are always ready. The more somatic activity of sex, on the contrary, reacts powerfully, and does not recover to its full extent for a considerable time.

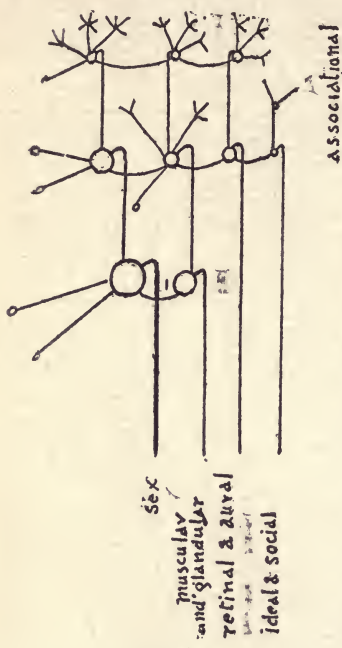

FIG 4.

The outer senses, too, and their intellectual derivatives are used for the most part symbolically, and with reference primarily to the inner and somatic sense, that euphoria of which the sex instinct is the best marked active outcome. When the outward senses become detached from their emotional background, as if the connection between r and r^1 (Fig. 2) were destroyed, their action becomes mechanical, while the underlying instincts, in the present case that of sex, either dwindle through lack of use, or discharge weakly without the assisting relays of the higher functions. An activity of the outer senses and the intellect, which is in close connection with the emotional background is the best arrangement for both. The higher senses and the intellect, however, act better prodromal to or independently of an actual sexual passion. That is, they act with a quicker reference to the outside stimulus peculiar to them. Under the influence of passion, although their energy may be as great, their stimulus and discharge are subordinated to the more somatic functions of sex.

General Features and Laws of Courting. Let us now turn our attention to some features of the sexual functions by which they are related to the general problems of life and the interaction of individuals. When a cell reproduces by division, both of the parts do more work in growth and assimila-

tion than before. Preliminary to division, as is most clearly shown in the protozoans, the cell gives evidences of disruptive tendencies. It has become so large that neither absorption nor excretion can be carried on with facility; it is necessary that its mass should be diminished with reference to its surface. Sometimes division occurs spontaneously; at other times, and more frequently, conjugation is necessary, as if the decided increase in size were a condition precipitating division. At this period, as we have already seen, katabolic changes and consequent evolution of energy are characteristic features. The tendency to destruction precedes division, and it would appear that the orderly carrying out of a disruptive process in division were the means which nature has adopted to overcome the necessity of death. It is at the moment of approaching exhaustion and imminent destruction that a cell divides, preceded or not by conjugation, and transmits the life which it is unable to retain. With the metazoan the case is not essentially different. Here the individual margin is greatly widened, but it is endowed with instincts inexplicable from the individual standpoint, leading it to shape its existence as if it were the bearer of a life more important than its own. An extension of the individual margin seems to follow only when there occurs some improvement which makes it more useful to the movement of the race. From this point of view, the individual appears as a debt which is owing to the reproductive processes in which life becomes eternal. Die to live, is at least one side of the law of sex.

The reproductive erethism is, thus, at the same time the result of high nutrition and the expression of decay. Physiological chemistry indicates that the products of assimilation rise in chemical complexity under favorable conditions found in the body. As the complexity increases they approach the critical point, where, with a slight change in the conditions, a new compound might be formed, but without which the already complicated molecules break up on the slightest shock and descend to simpler compounds. Life, and the sexual passion as its highest point, may thus be compared to a fountain, in which the water rises to a certain point,[1] falls over, and breaks up in every direction. The point of highest vitality is just before the beginning of decadence. The period of reproduction is the highest point of the curve, in which the anabolic and katabolic conditions are closely correlative, and are almost indistinguishably passing, one into the other. The anabolic is, however, more fundamental, and a pre-supposi-

[1] Cf. article on "Physiology," Ency. Brit.

tion of the latter. Accordingly, the male who is normally katabolic is just one step in advance of the female, who represents more persistently the inheritance of the race. Conversely, with the female, a more katabolic condition is always possible. We accordingly see, even among species when the male normally courts, instances when the female shows her ability to play a katabolic rôle, which has not been heretofore used by herself or her female ancestors. At the reproductive crisis, the female is just about to pass into the disruptive and explosive condition in which the male is, normally, already found.

Fear, a characteristic female emotion, becomes anger in the male diathesis. When fear and anger do not rise to a complete discharge in their own field of activity, like any outcome of nutrition, they fill up and strengthen the sexual passion, which flourishes only as it is able to absorb, use up, or overcome their fundamental energy. Without a certain preliminary erethism of fear followed often by anger, the sex potential could not rise to the height to which it does, and there would be less likelihood of the old hereditary channels being filled up and rendered productive in the sexual excitement, and less opportunity for the margin which results in sexual selection.[1] The examples of animal courting already given, and the more extended irradiated courting of phallicism, are evidence of these facts, and we have further confirmation of them in the phenomena of perversion.

The greater similarity of constitution of the two sexes in the sexual culmination, helps to account for their mental as well as physical *rapport*. The female is morally and mentally impregnated as well as physically by the superior energy of the male, just because she is on the point of passing into the energetic state herself, and, under certain circumstances, actually does so first. This also helps to account for the carrying out of selection on the part of the females. The female understands and appreciates the excitement of the male because there is already a similar tendency in herself. But while the constitutional symptoms are traveling in the same direction, the advanced condition of the male causes a difference at any given moment in the more representative or intellectual parts of the psychic states peculiar to each. With the lower animals, for example, the male reacts more quickly to the stimuli of food and climate and thus comes into heat sooner than the female. The periodic tension of the semen in man is to be regarded as a comparable hereditary

[1] Compare what has already been said under the head of Fear and Anger.

expression of these seasonal stimuli. The phantasy of the male seems to be more closely connected with his somatic condition, and under the influence of his stronger passions issues more quickly in a motor discharge. He therefore shows less calculation or selection, and is below the female in merely intellectual ability. It is a matter of frequent observation that men more frequently than women throw themselves away in a union beneath them.

The female, on the other hand, at the beginning of courting has before her the excitement of the male, which is interesting to her because she is approaching the same condition herself. There must, therefore, be a mental representation or imagination which re-echoes her own dawning emotion, but which is some degree in advance of it. This is in terms of the excitement of the male, which becomes the symbol for, and expresses the meaning of, her rising emotion. So, in sexual intercourse, the pleasure of the female may be largely the echo of that of the male, and yet her pleasure be none the less real. This has sometimes been referred to as sacrifice, but, if so, it is as amenable to the pleasure law as anything else. Here comes in the pleasure that is taken in pain. In many cases a woman loves to be hurt in a sexual relationship, if there are thus awakened representations of pleasure, often in terms of what is seen or felt as belonging to another, but which serve nevertheless, in normal cases, to awaken the inward movement which results in her katabolic climax. The initial stages of courting come, then, by association to draw the others into activity. They have a meaning, become symbolical, and may be fetichistic, as, for example, are the particular points, peacocks' spots, ball and socket ornaments, etc., so finely discriminated and emphasized in sexual selection. With the most of species this fetichism runs towards increasing the beauty and splendor of the male. Such a tendency is deeply rooted in the constitution of women, although the emphasis here, as we should expect in the human race, is moral and psychic as well as physical. The women of the Samogyan States do not believe they are loved by their husbands until they have received a box upon the ears.[1] In parts of Russia the woman collects and keeps in order the rods with which she is beaten. A stranger marrying a woman of this race found her unsatisfied and complaining to him that he did not love her. She requested him to beat her, after which she was contented and happy. Michelet[2] says in effect that in the first years of marriage, the young girl looks

[1] Krafft-Ebing, "Psychopathia sexualis," 7th ed., p. 140.
[2] "L'Amour."

to her lover to develop her love and mould her life. In this period he lays up permanently in her character a part of himself, which will react on him in later life when he comes to depend on her more as nurse and friend. The Provencal burden (translated by Swinburne) shows a similar trend:

> "Nay, slay me now; nay, for I will be slain.
> Pluck thy red pleasure from the teeth of pain,
> Break down thy vine ere yet grape-gatherers prune,
> Slay me ere day can slay desire again!
> Ah God, ah God, that day should be so soon!"

And Browning in a higher sphere of feeling:

> "Be a god and hold me
> With a charm!
> Be a man and fold me
> With thine arm!
>
> Teach me, only teach Love!
> As I ought,
> I will speak thy speech, Love,
> Think thy thought—
>
> Meet, if thou require it,
> Both demands,
> Laying flesh and spirit
> In thy hands."

It is in line with this phase of the psychology of woman, and in consequence of the physical attractiveness being largely left to her, that objects which excite a man's desire are often, if not generally, the same as those affecting woman. The female body has a sexually stimulating effect upon both sexes. Statues of female forms are more liable than those of male forms to have a stimulating effect upon women as well as men. In phallicism, says Rosenbaum,[1] the Lingam is an expression of male egoism and not physically attractive to either sex. The evidence of numerous literary expressions seems to show that under the influence of sexual excitement a woman regards her body as made for man's gratification, and that it is this complex emotion which forms the initial stage, at least, of her own pleasure. Her body is the symbol for her partner and indirectly for her, through his admiration of it, of their mutual joy and satisfaction. If a fixed idea or cramp should occur in this part of her phantasy, we would have a perversion similar to Masochism.

Corresponding to these features in the female, we find an unreflecting and active diathesis in the male. With the lower animals there is frank and undisguised display of their beauty

[1] "Geschichte der Lustseuche im Alterthum."

and prowess, a masterfulness which frequently amounts to cruelty. There is rarely, if ever, docility; as an attraction it would be wasted on the female. In man this is still the deepest tendency, and when fetichistic is evidently the basis of Sadism.

These characteristics of male and female courting tendencies are fundamental and form what might be called the first or primary law of courting, viz. :—

I. The male is physically active, but non-reflective, the female is passive, but imaginatively attentive to the states of the excited male.

Built upon this, however, and not really contradicting it, in some species, and in man particularly, there comes to be slighter tendencies in both sexes of an opposite nature. This is sometimes expressed by saying that men are becoming more like women, women more like men. This possibly may occur by way of degradation, but there is also a normal movement, involving a higher development, which arrives at a superficial resemblance at least.

With the restrictions of civilization, an imaginative radiation is greatly favored. Before marriage the woman begins to be hedged about. It is regarded as right that she, or her parents for her, should have the option of whom she shall know. Before the introduction, and in her general appearance afterwards, she spares no pains in making herself attractive, appealing to the taste of men in her manner, style, and dress. If the fashions originate with the Parisian demimonde, as Moll says,[1] there must be here a distinct appeal to the sexual taste. Woman comes to occupy the first stages of attraction, and to specialize on the physical aspects of beauty as being less important to the peculiar character of the human race.

Corresponding to this there is less physical activity, relatively at least, on the part of the male. The larger mental capacity, as well as the restrictions of civilization, favor the development of his representative powers. He comes to imagine how the woman feels, and becomes submissive and docile, waiting for the initiative of some one else. Chivalry becomes developed. Self-repression is necessitated. Fashionable society, with its delicate appreciation of manners, or good form, lives almost entirely in this sphere. All this is simply an evidence of a highly developed condition, which, irradiating into other departments, makes the difference between the savage and the cultivated man. In sexual congress itself, the increased representative powers of man make a dif-

[1] Cont. Sex. Empfind., p. 148.

ference. He has already passed through the relatively anabolic state, and knows by recent experience to what it leads. He is intellectually interested in its development, and the states of the female come to be, reflectively, the symbol and outward record or expression of his passion. To see and feel these secondary signs of emotion, to the more intellectual at least, are often of the greatest importance, and may even become, abnormally, so dissociated as to afford the whole means of gratification, instances of which we see in Masochism and inversion in men.

Data like the foregoing give us the material for a secondary law of courting, which normally operates only as an accessory of the first, viz.:

II. The female develops a superadded activity, the male becoming relatively passive and imaginatively attentive to the psychical and bodily states of the female.

In the operation of these laws in the life of love, both in the large rhythm of a whole life and in the shorter wave of a single sexual passion, the secondary tendency of both sexes acts as if it were marginal at the end as well as at the beginning, as in the flow and ebb of the tide, and with each of its waves, the water passes over the same ground twice. When the primary tendencies and the central sexual functions are exhausted, the more irradiated portions have had time to recuperate. The true, or at least the highly developed lover does not push away his mistress as he would the walnuts and the wine. He has an increased sympathy with her, and is more at her disposal than before. He occupies for a time the more feminine attitude characteristic of the secondary law in man. The same thing is true of advancing age and of the approach to maturity, the secondary or more highly irradiated tendency is more active in both. When r, r^1, etc., is exhausted or not yet active, the more irradiated portions absorb the nourishment (see Fig. 4). In the child the irradiated imaginative portions of the sexual system, corresponding to appreciation of art and nature, are in partial operation at least, before the advent of physical capacity.

Since in the full operation of the sexual passion the primary tendency is normally stronger, it follows that the male and female are not on equal terms. As a result of her greater coolness, selection falls naturally to the female, but it is like the selection of a guide to an unknown country, whom she must trust implicitly and follow blindly. Man is naturally more responsible than woman for the outcome of the sexual passion and all that depends upon it, and should be more the master and the guardian of woman's virtue and welfare than she can possibly be herself. It is an instinct of cowardice

that permits to woman equal rights, and, therefore, equal responsibilities in such a matter.

It is in line with this that man has for thousands of years been selected sexually, largely for his practical capacity, his active and moral powers, his sense of responsibility, than for his beauty. It is his capacity to admire, not coldly, the beautiful in woman, an active power, rather than his presentation of it himself, which is gratifying to woman and is normally selected by her. As Jennings says, the beauty which attracts sensually even women must be of the feminine order. Man rather than woman is the typical artist, since the production of art implies active admiration, although its appreciation quite consistently belongs more peculiarly to woman.

One thing remains to be said, which, if space permitted, should be more completely dealt with. If woman is the divinity of human love, it yet must be *one* woman who is the symbol of this faith. This is not merely a restriction of morality, but an outcome of desire. The widened consciousness of man demands it. He is now capable of taking in his whole life in one far-reaching impression. He is no longer merely the creature of the seasons. He does to-day what he knows will bear fruit in years to come. He feels that it is a paltry life that is made up of repetitions. So in love, he chooses forever, for better or for worse. Along with this comes a widening in the character of woman. She is no longer without a soul, as the polygamist believes. She becomes capable of development, so that, as the Greeks suggested in the story of Peleus and Thetis, in one woman a man marries the changing variety of the race. The advance of humanity towards monogamy has been an incomplete expression of this desire. The repetition of initial stages, as with polygamists, legal and otherwise, give no real development. The meaning of the world, and of love its best solution, is never reached or even named. The love of the modern man demands its systematization[1] in a single individual, who may become a symbol more than a complete realization both to herself and her partner of the mystery of love and the consequent enlargement and uplifting of all humanity.

With normal individuals it is, of course, the proper interrelationship of the courting laws that is the important feature. The *beau ideal* of a manly character, for example, is sometimes expressed by the phrase, "the iron hand in the velvet glove." Such a conception represents the harmonious operation of the courting laws, which, in a high state of civilization, are to be looked for in almost every department of life.

[1] Cf. Gaston Danville, "Psy. de l'Amour," and Max Dessoir in "Zur Psychologie der Vita Sexualis," in Zeitschrift für Psychiatrie, Bd. 50.

Degeneration. The phenomena of decadent sexual life indicate, no less than the history of irradiation in the past, its great range and complexity, its consequent plasticity, and its preëminent liability to injury and failure. A comparatively slight change, such as that involved in domestication, shows itself first, both in plants and animals, in the decadence of the sexual functions. This is in harmony with the fact that these functions occur only when the individual has come to maturity, and that they are, during this period, the expression of a metabolism which has arrived at its highest condition, and is thus ready to become kinetic and productive. It is evidently an advantage for both the individual and the race that the sexual functions should occupy such a position, and that reproduction should be the result of the highest individual vitality.

We have already seen that the superior organs of the genital system and their nervous attachments stand between the fundamental reproductive organs and the general system. Goltz shows that with frogs, after the ablation of the hemispheres, this centre is in the receptacules seminales and not in the testes. Where a rutting season is not found, as is the case with man, this tension must play a more subordinate rôle, although even here, with numbness of the higher centres, the lower will occupy their place. The sexual system in man is so much more highly irradiated and more complex that a term in that system considerably higher up would be the natural point of connection between it and the rest of the organism. It appears to the present writer that this pivot has come to be in man entirely psychical, and that it must be identified in a general way with what is commonly called the imagination, meaning by this no mysterious faculty, but simply the higher, more representative and symbolic reactions not directly connected with nutrition. We have already observed among the lower animals traces of the evolution of this phantasy. At first touch, then smell, then the higher, more symbolic sensations of sight and hearing, and finally mental representations, are the means used for bringing the sexes together at pairing time. In man, the imagination comes to be the normal organ of stimulation, with the full and free operation of which pleasure is intimately connected. It is, moreover, by means of this channel that the distantly connected activities of the body as a whole are called into the liveliest exercise.

It is, nevertheless, a very natural thing that the somatic sensations of the sexual passion, the thrill of pleasure that really belongs to the whole body, should be ordinarily objectivized and focused upon the already heightened

sensations of the particular sexual organs. Cases of priapism, however, show that the mere sensations of the surface are insufficient to give pleasure. The ejaculation centres must also be brought into play. But even when the spinal genital centres operate harmoniously and the sexual act is completely carried out, there still may be lack of pleasure and satisfaction. There may even arise disgust and misery. In such cases, very often the general somatic stimulus has been small; the heart beat, the thrill, the intoxication has been wanting, which, when it occurs, no doubt also increases the particular sensibility of the special sexual organs. Cases, however, present themselves plentifully, especially in the clinical literature of this subject, where pleasure of the most profound somatic character is experienced without any direct stimulation of the sexual organs whatever; where there is even a horror of coition, which is looked on as a beastly and degraded act. The pleasure here is often objectivized and focused upon some other sensation, at times apparently remote from those of sex. Sensations in different parts of the body, amounting often to pain, or the touch, odor, sight, sound, or imagination of various objects, serve to stimulate and carry into activity the whole force of the sexual passion. In the most of such cases, the history of these focalized sensations shows that they are in themselves originally indifferent, and only assume the importance they have, because they have been brought into contact, often at an early age, with the more somatic experiences to which they refer.

Unfortunate cases in normal life give evidence of the same character. Sexual union without exalted love or without the highest degree of love of which the individual is capable, such as may occur in prostitution or in loveless marriages, must leave a feeling of disgrace and dissatisfaction. The sexual organs may be exhausted, but the brain remains untouched. An irritation, founded on a deep longing for the discharge of these higher functions, remains—a sadness and sometimes anger supervenes, which, in morbid cases, may rise to an uncontrollable degree. The best of women, through the various arts in which they are frequently skilled—music, dancing, conversation, and the play of finished manners and address — have known how to call into healthy function the subtile but persistent irradiations of the sexual passion. When the imagination is touched, the heart is opened up, and the whole soul and body respond to their utmost depths. It is under this rebus that we should place the desire for a strong sensation, either given or received. The slightest sensations seem strong under profound somatic

excitement, since they are the outer focus, and therefore the expression of the whole condition. In order to repeat this pleasure, the individual desires again its objective expression, which appears to him the important part of the condition. The fact that this does actually tend to produce the pleasure sought for, is no evidence that the sensation has had a mechanical and assured effect like that of heat or light or sound. Its suggestibility may fully account for all the consequences.

Perversion. There are four natural groups into which the perversions, described for the first time in the clinical literature of the last ten years, naturally fall, namely fetichism, Sadism, Masochism, and inversion. These are, however, merely empirical divisions, and are by no means exclusive. Krafft-Ebing makes fetichism include cases when the sexual passion is focused upon some material object, some article of clothing, or some part of the body. The body itself, however, if the sexual passion be limited to that, may surely be as fetichistic as any part of it. From a psychological point of view, it is the narrowing of the means of representation and the exclusion of more adequate means of symbolism that makes the fetichist, who is thus, as Krafft-Ebing says, a monster by defect. The defect, however, is in the symbolism and not in the feeling which it awakens, for hyperæsthesia is almost a constant accompaniment of all such perversions. Fetichism is properly the failure of the intellectual or symbolical side, which is characteristic to a greater or less degree of all. The class to which the term fetichism is ordinarily limited is simply that in which this side is comparatively more prominent; Sadism, Masochism and inversion are also fetichistic.[1]

When the fetich is an object, it is most frequently some article of clothing or connected therewith, the naked body having sometimes an inhibitive effect. Binet[2] describes a case where the object of desire and the only stimulus to sexual excitement were the nails in the soles of a lady's shoes. Velvet and fur are frequently fetichistic, a fact which indicates the connection of sexual feeling with sensations of touch. Odors also have in some cases a very powerful sexual stimulus. The most frequent fetiches, however, are those which depend upon the sense of sight. Handkerchiefs and white underclothing are frequent fetiches of clothing. The parts of the body most commonly fetichistic are the eye, the hair, the hand and the foot. These are the parts that are most ordinarily exposed, and will therefore be most likely to stamp them-

[1] Cf. paragraph on symbolism and fetichism.

[2] *Revue Philosophique*, July to Dec., 1887, "Le Fetichisme dans l'Amour."

selves upon the phantasy under conditions of sexual emotion.

Mental characteristics may became fetichistic. J. J. Rousseau's case is a classic example.[1] Bodily defects even become attractive. Des Cartes' preference for squint-eyed women is an instance. Dr. Lydston of Chicago[2] gives a case of a man who, after a liaison with a woman with an amputated leg, was satisfied only with others having the same defect. The time of the day may become fetichistic. Garnier[3] gives a case where, on account of early associations, coition was impossible except in the morning. Even attraction for an individual may be fetichistic, and may be felt to be degrading, although too powerful to shake off. Daudet, in his novel "Sappho," makes a very suggestive study of this feature of illicit love.

Next to the general neurasthenic diathesis, which lies at the basis of all perversion, and the morbid working of the phantasy, perhaps the best marked characteristic of fetichism is the existence of a second life,[4] a segmented or divided self which may be colored by sexual love, but unable to come to fruition in the sexual act, or if so, with a diminished amount of pleasurable feeling. The reactions excluded or cut off from the stimulus of sexual gratification still keep up for a time an independent existence. Krafft-Ebing's Obs. 44, 45, 46, 47, 48, 49, 50, 53, 54, 60, 64, 76, 86, 108, 109, 110 and many others give evidence of this division. Obs. 44 gives a typical example of a pervert, in whom the reception of blows and wounds played a good part in his sexually-colored imagination, while he often had the most enthusiastic inclination for young girls of his acquaintance, but not connecting this in any way with his sensuous thoughts. In his dreams, also, these two circles of erotic presentations never mingled. Both spheres were for him a kind of *poésie*, but they remained two separate worlds.

The lack of coincidence of desire and pleasure has been frequently noted, and is an evidence of a form of segmentation. Dr. Mathews Duncan[5] describes this condition as very common with women. With fetichists, as with normal individuals, desire may be exhausted without pleasure, which is dependent, as most of these cases show, upon the suitable stimulus of the sensuous phantasy. Krafft-Ebing's Obs. 86[6] is illustrative. The alternation of waking and sleeping also

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[1] See his "Confessions," and Binet, *op. cit.*
[2] Lecture on Sex Perversions.
[3] "Anomalies Sexuelles."
[4] Cf. Pamphlet by Dr. Moritz Benedikt on "Second Life."
[5] "Sterility in Woman."
[6] *Op. cit.*

bears upon segmentation. The functions of the brain when dreaming, although connected with the waking life, have a considerable degree of independence. This is doubtless due to the fact that the higher centres are not in full control. There comes thus to be formed a sort of second self, a quasi-personality, to which the sex functions particularly become relegated. The normal form of this connection is indicated in emissions accompanied with dreams.

The presence of dreams is regarded generally by physicians as a sign of health. Dreamless emissions are on the road to become dangerous, leading to emissions without erections, and showing a weakening of the psycho-physical connections of the sexual apparatus. The subconscious region, which controls the dreams, comes into play in sexual congress and is normally led by the higher centres. If it is then properly fatigued, it is not aroused for some time in dreams. There are several cases that show that when these psychic centres are not so fatigued, emissions may occur very shortly after coition.

A collection of erotic dreams made by the present writer, from a number of normal individuals, indicates that dreams accompanying emissions are frequently Sadistic, Masochistic or inverted in character. Such dreams under unhealthy nutritive conditions might become the starting point of fetichisms of different kinds. They might more readily lend themselves to fetichisms where coitus is unnecessary, as in emissions the male organ is without the stimulus of contact. It would seem that this source might favor inversions particularly, since the imagination here still uses a whole person, although it fails to involve those higher ranges which are concerned with future generations and the destiny of mankind, and those deeper and more intensive hereditary æsthetic feelings which are associated with the presentation of the female sex. Wide somatic reverberations or complete erethism must be absent during sleep.[1]

The fact that hypnotism has been the most successful agent in the treatment of cases of perversion, shows the importance of the underlying or divided-off part of the personality, and the danger in not recognizing it, developing it, and bringing it into connection with the normal life.

Leaving the consideration of the more intellectual or formal side, let us turn to those perversions where the kind of feeling is the important feature, and where the fetichistic object or action may vary considerably with the same individual so long as it serves to focus the abnormal emotional condition.

[1] Cf. Mercier in "Discussion on Imperative Ideas," *Brain*, 1895.

As we saw in studying the sexual habits of the lower animals, courting and combat are the constant preliminaries to sexual gratification. These shade into one another, courting tending to take the place of the more basal form of combat. The passions which thus come to be associated with love are those of fear and anger, both of which, by arousing the whole nature and stimulating the nutritive sources from which they flow, come to increase the force of the sexual passion to which they lead up and in which they culminate and are absorbed. Even here we saw traces, as with the woodgrouse's cruelty to his mate, of the morbid or excessive action of these underlying passions, evidences that they had not been completely overcome, that love had not been sufficient to cast out fear and anger. In the more emotional perversions of Sadism and Masochism, we find a relapse to these primitive passions. In Sadism[1] we find this special toning of the emotions to run in the direction of anger. The fetichists here are active and often violent. In Masochism[2] the opposite condition is found. Fear or related emotions, a sense of being mastered and a delight in it, are the general features. To these are to be added various forms which are related to one or the other of these salient classes.

As already indicated, the relapse to the underlying passions of fear and anger is accompanied with and sometimes caused by fixed ideas or fetichisms in the primary or secondary courting tendencies. Masochism in women is rare; even fewer cases are reported than of Sadism. This is in harmony with the normal Masochistic tendency of women. Masochism in men, on account, perhaps, of the greater difficulty in bringing it into contact with the actualities of life and the consequent imaginative concentration, offers very many cases. It is, moreover, from the representative side, connected with a fault in the secondary courting tendency which embraces more highly irradiated and therefore less firmly established reactions.

Masochism, as many of the cases show, occurs along with its apparent contrary, Sadism. It seems quite possible that an originally Masochistic feeling might pass into a certain degree of Sadism. Under the action of the secondary courting tendency, a man comes to speculate on and to dwell upon representations of the woman's sexual states. What he first observes would naturally be reactions of her secondary tendency, but his penetration might discover, or chance might place in his way the observation, that many women love to

[1] So called from the notorious Marquis de Sade.
[2] From Sacher Masoch, the author of "Venus in Furs."

be ruled and even humiliated, so that from a Masochistic motive he might become somewhat Sadistic at least.

Sadism in women ought to be connected with a more irradiated portion of the imagination than in men. In the preliminary anger scenes in the lower animals, the female is taken up mostly with observing and watching the cruel activities of the males. Known cases of female Sadism are few, but support this idea.

History presents some terrible examples of Sadistic passion. Nero, Tiberius, and the famous Marquis Gilles de Rays, who, during the space of eight years, tortured, violated, and killed, over 800 children, are classic examples. The latter monster declared that these acts gave him inexplicable happiness. He burnt the bodies and kept a few of the prettiest heads as tokens.

Sadistic fetichism in men offers the reverse of almost every kind of act to be observed in Masochism, although the proportion of symbolic acts seems less, and those involving the direct contact of the desired experience greater than in the former class, a fact in harmony with Sadism being a perversion of the primary courting law.

Inversion, or contrary sexual sensation, is a perversion which crosses all of the previous classes, but among the published cases at least, leans more to the passive or Masochistic form. This coincides with what is known of the peculiar societies of inverts. Coffee-clatches, where the members dress themselves with aprons, etc., and knit, gossip and crochet; balls, where men adopt the ladies' evening dress, are well known in Europe. "The Fairies" of New York are said to be a similar secret organization. The avocations which inverts follow are frequently feminine in their nature. They are fond of the actor's life, and particularly that of the comedian requiring the dressing in female attire, and the singing in imitation of a female voice, in which they often excel.

Raffalovich,[1] however, suggests that the cases that are described are morally the weakest, and correspond more closely to the female character. He thinks there is another more masculine although less known class, who prefer to inhibit their sexuality rather than gratify it in a way which, although natural to them, is at variance with the best instincts of humanity. "As men they love men, but they affirm that if they were women, they would love women." He thinks that here "we shall find ourselves in the presence of a new class adapted for celibacy, for study, for religion (since the realiza-

[1] "Uranism," *Journal of Comp. Neurology*, March, 1895.

tion of their desires is not of this world). Like the ideal physician of Plato, the best of them will be of sufficiently weak character to understand the sins of their fellows, and of sufficient strength of will to make themselves useful." Max Dessoir reports a case somewhat corresponding to this conception.[1]

Some of the cases that have been called inversions are evidently part of a profound degeneration of the whole constitution. The physical characteristics are sometimes so ambiguous that it is impossible to decide from the outer form or observation of the genitalia, whether the individual is male or female. Such cases, however, generally have their feelings in harmony with their real sex, and at other times relapse to a neutral and unsexed condition of feeling rather than to a state of inversion. The virago is generally of this character, the loss of femininity, growth of hair, etc., being more like the changes that follow the menopause.

In the most of the cases of known inversion, however, in which too the physical form is perfectly normal although the desires are generally female or passive, the imagination or sensuous phantasm seems to form the turning point of this part of their nature. As in normal life, especially with the young, after reading a novel the characters sometimes float before the mind as real persons, but at other times, by dint of a strong imagination, the reader picks up the very state of mind and character of the hero or heroine portrayed and acts it out in his own life, until he insensibly becomes the character represented as far as he is able to understand and imitate it. So, with an early awakening of the sexual passion, which comes in first in childhood through its most irradiated terms, it might be expected that a boy who either associates too much with girls, or who is excluded entirely from their society, might be led to make many representations to himself of their state of mind and feeling as well as the condition of their bodies while he is still too young to connect this with sexual realities, or, in some cases, to imagine them as physically different to himself. This would be a condition of hyperæsthesia of the secondary courting tendency, and might easily lead to a fetichism or fixed idea in this region. Such inversion would thus, as Ribot also claims of all real inversion, begin from above.

There are many cases which support this view, but Krafft-Ebing's Obs. 99[2] is an exceptionally interesting one, because it shows the development of a case of inversion from almost

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[1] "Zur Psychologie der Vita Sexualis."
[2] *Op. cit.*

a normal condition to abhorrence of coition and even illusion of contrary sexual sensation. The case is autobiographical, and many of the feelings described are certainly not of the kind which would be likely to come to consciousness in a woman's mind, but which a man might very readily imagine a woman to have.

A case of inversion observed by the present writer at the Worcester Asylum for the Insane (under the direction of Pres. Hall, and by permission of Dr. Quinby, the superintendent), indicated the same anxiety to regard himself and to be regarded in a feminine attitude.

Ecstasy. The state of ecstasy as involving an emotional condition accompanying the operation of the phantasy is the connecting link between sex and art. Ecstasy is related, as Mantegazza points out,[1] on the one side to hypnotism, on the other to narcosis, although it is a condition more exalted than either. The morbid sex states, particularly, show their connection with hypnotism, and there is a similarity between the sex states generally and the class of phenomena Havelock Ellis[2] groups as hypnotic, including here somnambulism, hypnotism, ecstasy, trance, and catalepsy. These are all characterized, says he, by a decreased control of the higher nervous centres, and an increased activity of the lower. This may be admitted as true, relatively at least, of a certain stage, generally the climax of these states, but before this is reached the operation of the higher centres forms a necessary prelude. The fact that the hypnotic subject must be willing, with some very few exceptions, to receive treatment, the difficulty or impossibility of hypnotizing idiots, and the increasing possibility of hypnotic phenomena, as we ascend the animal series, show that in some way the higher centres are an important factor. This is particularly true of the more impressionable stages. Moll[3] says there is no suggestion without consciousness. Epilepsy, which is related to these states, begins, as the aura indicates, in the higher centres, advances, apparently, to a cramp among the motor cells of the cerebrum, and from there affects the whole motor system, which otherwise may not be diseased. Catalepsy, which presents an exaggeration of the muscular contractions common to all these states, has been explained as an exceedingly rapid series of innervating shocks from a lower centre, unable at the time to be checked by the inhibition of a higher one, in which case the process must go on until the lower centre is exhausted. Rieger[4] shows by tracings that those in a hypnotic state are

[1] "Die Ekstasen der Menschen."
[2] "Man and Woman," p. 258.
[3] "Hypnotism."
[4] "Der Hypnotismus," June, 1884.

more capable of continuing a contraction, keeping the arm extended, for example, at a certain point, but that the oscillations which indicate a loss of higher control or power of adjustment are greater than in normal subjects. Dr. G. Stanley Hall[1] shows that the reaction time in a hypnotic condition is more rapid than with normal subjects.

Generally speaking, it is thus a characteristic of these states that the associational processes are diminished in number and delicacy, but that those that do exist are more prominent and act more fatally than with normal people. The climax of these states is obsessional, but they involve a marginal associational activity of greater or less duration.

With repetition, as with fetichisms generally, a certain association becomes more firmly fixed, and the obsessional state more rapidly reached. Dr. Rieger found that a patient hypnotized by gazing at a pencil was afterwards more easily hypnotized by the use of a pencil than otherwise. With patients not well habituated, all distracting associations must be guarded against; the slightest noise, as the closing of a door, is sufficient to delay the desired effect. There seems to be a period when these stray stimuli have a much more than ordinary effect, as, indeed, with normal people on going to sleep.

Imperative ideas, or fragments of the phantasy, act in a similar manner.[2] The sex act in many animals may be compared with these states. Where the prodromal stage is extended, we have fascination similar to that of hypnotism; when cut short, as with the rabbit, it is most like an epileptic fit. The woodcock, described in the section on courting, after alighting, and before balzing begins, appears to be hyperæsthesic to all disturbing noises, but later on is not frightened even at the report of fire-arms. With the females in most cases the prodromal stage is more than ordinarily well marked. It is, as we have seen, the period of selection, in which the higher senses and the brain receive their highest stimulation. It is the symbol forming stage. Sensations of sight and hearing come to be symbolic or representative of those of touch and inner bodily feeling, and the higher, more complicated operations of the phantasy for all that exists below it.[3]

As the argument of these pages attempts to indicate, the somatic resonance of art is sex. The art psychosis is primarily an irradiation of sex, but when firmly established in the

[1] *Mind*, No. XXX.

[2] Cf. Hughlings, Jackson, Savage, *et. al.*, in "Discussion on Imperative Ideas" in *Brain*, 1895.

[3] Recent investigations on circulation in the brain connect higher arterial pressure with diminished capillary circulation. The small-

associational tracts to which it belongs, it may act more independently, and thus become an inhibitory agent, protecting and blocking the way between the external stimulus and the underlying hereditary reactions. This depends upon the extension of the associational stage, which must not be regarded as entirely impartial or indifferent, but as being extended by means of irradiation from the more frequently occurring events to those more rarely used.

There are two conditions which will permit the penetration of this region. Normally, when the associational tracts are completely occupied or surcharged by stimuli of various kinds, any additional stimulus will break through and lead to a discharge along the more deeply seated hereditary centres. Any exceptional erethism of the brain, as in reading or composing, where the associational tracts are mainly involved, puts the individual in a more susceptible condition. Involuntary emissions during sleep are frequently precipitated by such a previously erectile brain condition, even when the mental content has been entirely neutral from a sexual standpoint. The sentimental conditions generally (associational) are prodromal to sexual states. Grief, essentially an affection of the associational tracts, with a comparatively shallow, although persistent, somatic resonance, which, moreover, is generally connected with love, frequently favors sexual attachments. Other things being equal, the more intellectual an individual is, the more difficulty there will be in filling these associational tracts. His choice will be more discriminating and refined. As he becomes older, with the waning of the unused or less used somatic reactions and the increase of associational power, he will be still harder to please, or, in other words, the associational tracts will be harder to fill.

The second condition is where the associational tract is worn down by repetition or too early use, and the path is thus made easy for discharge to the lower centres. This we find with fetichists and with those given to sexual excesses generally. Here the rest of the associational tract remains unused. The fact that perversion usually begins in childhood is in harmony with this, and is evidently connected with the general law that the full complement of associational brain connections are not developed till late.

The associational tract may, of course, also be filled up from beneath, owing to the somatic stimulus of the sexual glands. This stimulus has come to be in man, as both perversions and

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est capillaries which subserve the finer reactions will of course suffer first. This is in harmony with our general view as to the course which the æsthetico-sexual erethism follows in a highly developed animal, and with the succession of the courting laws.

the history of normal cases show, a highly controllable factor.

Fear and anger as associated somatic reactions will increase the width of the bodily excitement, at first lowering, and, finally, if the proper stimulus occurs, raising the sexual potential much in the same way as in the strictly associational or intellectual regions.[1]

It is not to be understood that the art psychosis involves merely an intellectual surface. The associational region itself must have a certain depth. The art psychosis is essentially a state of ecstasy, with a tendency to produce a slight obsessional climax, as with sex itself and all of the hypnotic states, but it is an ecstasy in which the prodromal or associational stages are extended in proportion to the development of the art consciousness of the individual. If the art psychosis has not been developed, stimuli which ought to expend themselves in this region lead more directly to the distinctly sexual stage, as when the uneducated are confronted with the nude in art, or in the case of men who cannot look at a pretty woman without lusting after her in their hearts. The little ecstasy of art with its wide prodromal stage is, it seems, an equivalent of, and an inoculation against, the larger ecstasy of sex, a condition which normally obtains until the associational tracts are filled.

Putting this graphically, let us suppose that the oblong *a b c d*, Fig. 6, contains a certain associational tract radiating from 3, the discharge of which is accompanied by a feeling of ecstasy. This helps to fill up 2, and if the path is open to 2[1], to increase the radiation along a lower plane, an event which will give a wider somatic resonance to 3. If this path should be blocked or filled, and already on the point of discharge, the overflow will lead to *1*, which represents the central activities of sex.

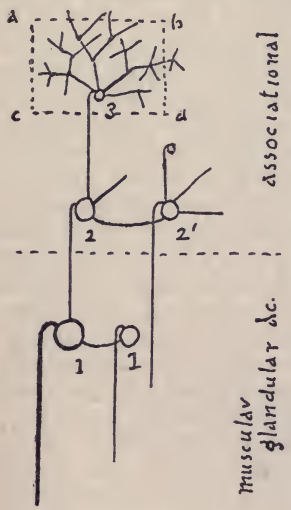

FIG. 6.

With the use of the indirect channel, the higher centres are in more frequent activity, and since pleasure, as we have seen in our study of perverts, is an outcome of these centres, the increase of the art psychosis is a gain in pleasure possibilities.[2]

[1] Cf. paragraph on fear and anger and Fig. 2.
[2] Cf. Marshall, "Pain, Pleasure and Æsthetics."

When the muscular and general glandular centres are thus called into action through the indirect channel, their activity will be of the nature of love, as the stimulus which incites them arises from a radiated portion of the sexual system. The painter's touch, the singer's note, the preacher's persuasive and passionate words, the succession of movements in a dance, the increasing intensity of drama and opera, follow the sexual curve, as does less definitely any muscular or vaso-motor activity capable of producing pleasure.

Besides the distinctly art psychosis, there are many other varieties of ecstasy that might be compared with it. Mantegazza has given a sort of natural history account of many of these. Certain forms of them, those of science, for example, seem to be a more direct irradiation of nutrition than is the art psychosis. But even these in their highest manifestations, when truth is sought for itself alone, do not differ essentially from the highest ecstasy of art.

Æsthetics. Turning briefly to the more differentiated phenomena of the art psychosis, we might notice imitation as a process which has from the time of Plato or earlier been associated with art.

The pleasure arising from putting one thing in terms of another, as we may put the world in terms of retinal color stimulation, as in painting, or in terms of natural objects, flowers, trees, etc., as in much myth and poetry, is at least part of a psychosis distinctly artistic. There is in this operation an element of the subjective or controllable, as Prof. Royce points out,[1] but underlying this there appears to be a deeper motive, or necessity of the individual constitution. Artistic imitation, if it is to have any meaning at all, belongs to a wider class, that of the formation of symbols, and is thus always more than a translation, however free. When a person imitates the movements of another for the purpose of mocking him, saying, "This is the way you do," there must be something more than the model and more than his imitative acts to account for the definite direction of his effort. This is certainly a subjective state, but it is largely uncontrollable. The observed act and the controllable deed are outward symbols of this inner and spontaneous feeling, and give what is called the meaning to both the terms compared.

The whole movement of metaphysical æsthetics has been, as Bosanquet very ably shows,[2] a progress from the dominance of the idea of imitation as an explanation of art to the recognition of characterization, meaning, or significance as of the

[1] *Psy. Rev.*, May, 1895.
[2] "History of Æsthetics," 1892.

first importance. From the metaphysical standpoint this emphasis of meaning culminates in the "idea" of Hegelism, "which is the unity of the world interpreted on the analogy of the intellect,"[1] and with certain modifications Schopenhaur's "idea" occupies a similar position. Supplementing this, and marking an advance towards psychology, Bosanquet himself offers the following conception:

> I suggest as an approximate psychological definition of æsthetic enjoyment — "Pleasure in the nature of a feeling or presentation, as distinct from pleasure in its momentary or expected stimulation of the organism." Such pleasure would always, it is my belief, be connected in fact with the *significance* of the content of feeling. . . . . If anything in the region of taste, smell, touch, heat, or cold has a value akin to that of beauty, it is not surely either the strongest or most delightful sensation, but rather the most suggestive sensation, or that which is most highly charged with associated ideas, so normal that we do not take them to be accidental. Not the scent of eau-de-cologne, but the smell of peat smoke, or of the sea; not the comfortable warmth of the house, but the freshness of the morning air, are sensations of a kind in which we may feel a certain disinterested delight not wholly dissimilar to æsthetic enjoyment. The merest germ of the sense of beauty seems to imply a distinctness between stimulus and significance.

It remains for psychology to identify this significance with, or at least to base it upon, hereditary affective reactions actually occurring within the organism, and which, as these pages attempt to indicate, are primarily irradiations from the region of sex.

Aristotle's theory of the drama as a representation or imitation affecting a katharsis of the passions of pity and fear, bases its operation psychologically on these deeper emotions which we have claimed as most closely connected with sex and art. From this point of view, there is much to be said in favor of regarding the drama as the typical fine art. It is, from the point of view of the material used, primarily an exploitation of movement, to which it adds all the higher sensuous and intellectual pleasures. The courting scenes of the lower animals are essentially dramatic. The early festivals and phallic ceremonies of lower races centre around dancing and the drama. Music and poetry plainly show their derivation from movement. Painting is no more passive than any of the other arts, but implies the movement of the eye for its appreciation as well as the sympathetic intuition of the muscular movements and subtle emotions (suppressed movements) of the original artist.

With undeveloped, badly developed, or decadent art, the symbolism, normally expressive of emotional depth, and correspondingly wide and fluent, becomes fetichistic and narrow.

[1] Bosanquet, *op. cit.*, p. 304.

In students' college papers and journals, Dr. Drew[1] recently examined 356 poems. Of these, 26 were indefinite, or referred to love but incidentally; 270 made mention of particular physical charms. The features most noted were: eyes, 91 times; hair, 51; face, 24. Among the poets who referred to the face, 13 were charmed by its brightness, 4 found it sweet, only 1 noted an intelligent face. The modern French decadents and symbolists show decidedly fetichistic signs, both in their neglect of the wider scientific, social, and philosophical experience of the nineteenth century and in their arbitrary choice of words.[2]

Conclusion. Art, like sex, is, however, in its best conditions essentially an overflow of health and strength, an outcome of the highest metabolism of the organism. Its dynamic power is thus the most intense, its influence on the individual profound and purifying. Can education and philosophy neglect such a power?

It is to the young adolescent that its importance is greatest. On the one side we have the great passion of sex, unknown, budding, creating modifications that have well been called regenerative, a passion so plastic, so loosely knit together that the slightest accident suffices to decentralize and change the whole current of its life; on the other, vague hopes and aspirations, transcendental longings, poetic yearnings, a craving for sympathy and recognition. Shall grammar and algebra, or even the whole curriculum of the ordinary college, suffice to assuage this instinct? The "breakings out," the orgies, the sexual immoralities of student life, though less common, perhaps, among students than with other unmarried adolescents, yet indicate an overflow, a waste of energy, that mere repression, mere loading, will never curb, but rather repel when it does not destroy.

Why can not this plastic passion that underlies these manifestations be turned into channels where it may naturally flow? Does not sex itself produce its own best organ of inhibition in the love of the beautiful and works of art? Why should the best youths of our land be excluded from such a culture at an age when it would serve to engage the enthusiasm of many who are left cold by the dryness of academic literature, science, and mathematics? The history of art, a knowledge of architecture, archæology, and formal drawing, however useful in its way, does not touch the heart of the problem. These are not a natural overflow of our modern thought and feeling. The real work of art, as Taine says,[3]

[1] *Pedagogical Seminary*, Vol. II.
[2] Cf. Lombroso, "L'Homme de Genie."
[3] "Phil. of Art," trans., p. 180.

"is determined by an aggregate which is the general state of the mind and the surrounding manners." "Fill your mind and heart," says Goethe, "with the ideas and sentiments of your age, and the work will follow." Art is one, and each of its branches is affected by each of the others, but there is yet a truth in Hegel's conception[1] of the movement of the centre of gravity of art among the different arts as time moves on. At the present, poetry, painting, and music have each blossomed out in distinctly modern forms. These represent the natural overflow of our age, and these most recent evolutions are the material to quicken and purify the life-blood of our youth.

It may be said that the student may find this inspiration in the professional schools of art. But these are technical schools, and should be designed to meet the needs of those who intend to make the profession of art their work of life. They stand in the same position to the college and the university as do the schools of engineering, the schools of divinity, pedagogy, law, and medicine. This does not meet the real needs of education, where culture should be followed for the sake of its ennobling and uplifting influence, for the awakening of ideal interests, for the purifying and perfecting of the highest individual capacity. The student may neither want to paint, nor play, nor write, nor may he wish to dissect formulæ, or study specimens of ancient art. What he desires is to come into real and intimate contact with the life that fills our modern art, to appreciate and enjoy, and to feel with his very heart the ecstasy of love that art forever offers at nature's shrine. It is time that the art education of this country was put upon a psychological basis, its powers and possibilities recognized and turned to service in the cause of education.

"Who does not in this period," says Krafft-Ebing, "grow enthusiastic for the sublime and beautiful, remains a Philistine for the rest of his life."[2]

To quote Guyau[3]: "Art aids in the full development of life and becomes a gymnastic of the nervous system, a gymnasium of the mind. If we do not exercise our complex organs, they will produce in us a sort of nervous plethora, followed by atrophy. Modern civilization, which multiplies capacities

[1] Cf. his "Æsthetic."

[2] A study of children's drawings by Earl Barnes of California shows where the interest of the pupils lies, and this is where education should be applied. The rude figures that children love to draw on their slate, often the *bête noir* of the unintelligent teacher, are really much more artistic than the cubes and squares and conventional designs which they are compelled to copy. They are, at least, expressive and sincere.

[3] "Problems d'esthétique contemperaine," p. 10.

of all sorts, and by a true antinomy carries the division of functions to an excess, needs to compensate for this inequality by the varied play of art. Art has, then, its rôle in human evolution, and its extinction, perhaps, would mark the end. Our organism, as it improves, will come to economize more of its force, like all our machines, and in this way will always have a quantity in reserve. It is art that ought to employ the surplus of force unused by the ordinary demands of life. Art will thus double and triple our existence. A life of imagination will be superposed to that of real existence, and it is this that will irradiate the overflow of our sentiments. Art will thus be the perpetual return of all our unemployed faculties. One can conceive that art, this luxury of the imagination, might finish by becoming a necessity for all, a sort of daily bread."

Art, standing as it does between religion and philosophy, is in one sense, or in one of its stages, a criticism of life, as Matthew Arnold says of poetry. This is the most external, prodromal, or associational phase. It is in its deeper moments rather the creation of life. It gives men thoughts and experiences, and it thereby forms the experiences they already have. The artists are the makers, and are continually preëmpting the regions that have been heretofore unconscious. Says Walt Whitman, they "are not the followers of beauty, but the august masters of beauty," the "answerers," as he calls them, speaking of poets, or the makers of ideals.[1] This is the only sense in which all the arts are poetic. Painting, for example, is not poetical in proportion as it treats some literary theme, but in the proportion in which it issues categories and gives humanity a new and, perhaps, a deeper way of seeing things. A painter lends his eyes out, as Browning says, and his heart and brain as well.

It is love in its best development in a continued married life that gives us the pulse of this movement. The early periods of courting are times of intense criticism. Association and comparison are the necessary accompaniments of selection. But with a happy marriage the mind no longer has a feeling of estrangement. The stilted, formal conversation, the fear of pauses, the morbid solicitation, the critical spirit which haunts us in ordinary social contact, even when intimate and free, leave us entirely in the presence of the woman whose heart we know, and whose body and soul we love. We then become truly original, truly ourselves; thoughts come, impulse is free, creation is achieved.

The ennobling ecstasies of poetry, music, painting, and the enthusiasms generally, are at the same time an outcome of, and a substitution for this happiness.

[1] Cf. Havelock Ellis, "The New Spirit."

ON THE DEVELOPMENT OF VISUAL PERCEPTION AND ATTENTION.[1]

By Harold Griffing, Ph. D.

(From the Psychological Laboratory of Columbia College.)

It is well known that a number of simultaneous impressions on the retina can be perceived when the time of exposure is so short as to exclude successive attention.[2] The extensive threshold, as the greatest number of objects thus seen may be called, varies with different individuals and doubtless many other conditions. The object of the experiments now to be described was to determine some of these conditions, especially those relating to the age and development of the observer. As the accuracy of perception clearly depends upon attention, I hoped also to obtain some data bearing upon the development of voluntary attention.

The apparatus used was constructed on the same principle as the gravity chronometer of Cattell and the tachistoscope of Volkmann and Wundt (see Figure 1). The objects to be perceived, which were letters, were pasted on white cardboard. This was placed on a wooden upright board. In front of this board is a movable screen of cardboard *AB*, with a rectangular opening, which, when allowed to fall past the objects, exposes them for the time taken by the opening in passing. The screen is let fall by the operator, who pulls the string attached to the clasp *M*. The noise of falling is greatly lessened by layers of felt in the screen holder *S*. The entire apparatus is hidden by a curtain *CD*, with a rectangular opening *OL*, where the stimulus *HK* appears. The

[1]The experiments to be described were partially planned in conjunction with Mr. S. H. Rowe, formerly Fellow in Education, Columbia College. On account of absence in Europe, Mr. Rowe was unable to continue the research.

[2]For previous investigations on the subject, see Cattell, *Philosophische Studien*, III, or *Brain*, XXXI.

advantage of the curtain is that an observer is ignorant of the movement of the screen, except as he perceives the objects exposed or the white background upon which they appear. In the centre of the opening of the curtain, and attached to the curtain by thread, is a small white cross *F*, serving as a fixation point. The entire apparatus is painted black. The time of exposure in these experiments was $\frac{1}{10}$ second.[1]

With this instrument the writer made a large number of experiments on school and college students, mostly from the

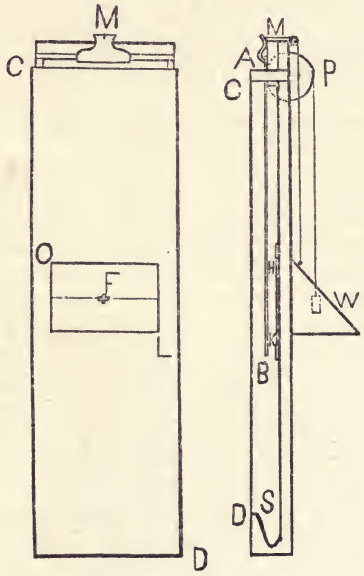

Fig. 1.

Horace Mann School of the Teachers' College and the School of Arts in Columbia College. Ten successive experiments were made on each group of observers, the number in a group varying from ten to thirty. The groups were arranged in approximately a triangular shape, so that all could see distinctly anything near the fixation point. In each experiment the stimuli were six capital letters arranged in two rows of three each, and presenting the appearance of an approximate square. The letters were printed for the purpose, and were 48 mm. in height. The combinations of letters were as fol-

[1]This time was obtained theoretically from the formulæ of mechanics.

lows: (i) YOG LNA, (ii) EVX MHK, (iii) UJR ZWD, (iv) NXA GFO, (v) DRK LSI, (vi) YZB CTP, (vii) JNW HVE, (viii) TSX LFA, (ix) CDI RGK, (x) OBP UJM. They were selected so as to avoid, if possible, any decided difference in the legibility of the different groups. For this purpose I used the results obtained by Prof. Cattell for the legibility of letters.[1] In conducting the experiment the observers were told to look at the fixation point when the signal "ready" was given, and to continue to look at the fixation point until the letters appeared, when they were to write down what letters they saw. They did not know how many letters would appear, and care was taken that they could not know when to expect the stimulus. The purpose of this was to test the observer's powers of prolonged attention. If he was not attending, at least to the extent of looking at the apparatus, he could not see anything.

The fact that some observers were necessarily in more favorable positions for seeing than others may, we think, be neglected. In the experiments on three different groups those unfavorably seated had about as good records on the average as those favorably seated.

In the experiments on the college students, the first that were made, the intervals of time between the signal and the appearance of the stimuli were $\frac{1}{10}$, 1, $\frac{1}{2}$, $1\frac{1}{2}$ and $\frac{1}{4}$ minutes, and the same for the second five of the ten experiments. As the results showed no effect of fatigue, and as the writer wished to obtain some data on the subject, in the succeeding experiments on pupils of the H. M. S.[2] the intervals were increased, being $\frac{1}{3}$, 3, 1, 4 and 2 minutes.

I now give the results of the experiments for the different classes, I being the lowest primary of the H. M. S. The high school pupils include four groups from the H. M. S. and two private schools,[3] and the college students include five groups from Barnard and Columbia Colleges.[4]

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[1]Cattell, *op. cit.*

[2]I will, for convenience, use this abbreviated form for the Horace Mann School.

[3]Mr. Browning's school for boys and Miss Gibbons' school for girls, both in New York.

[4]I take pleasure in here expressing my thanks to the school and college officers who have given me the opportunity to make these tests.

TABLE I.

Average Total Numbers of Letters Seen by Classes.

N.	C.	S	MV.	R.	MV.	MAX.	MIN.	$\frac{R}{S}$
22	I	8	6	3	3	17	0	.4
16	II-III	13	8	6	4	19	0	.4
12	IV	16	6	7	3	13	1	.4
17	V	18	5	14	4	22	3	.8
17	VI	22	10	12	5	25	0	.5
23	VII	19	7	14	5	23	0	.7
23	VIII	25	7	21	6	37	8	.8
84	High	30	5	23	6	47	4	.8
75	Coll.	32	6	29	6	59	11	.9

N. = number in class.
C. = class.
S. = average of total number of letters written down as seen in ten trials, six letters being given in each trial.
R. = average of total number seen correctly.
MV. = mean variation of S.'s or R.'s of the individual averages from the averages of the groups.
MAX. = maximum of total number seen correctly by any individual.
MIN. = minimum of total number seen correctly by any individual.

In table II are given the results for students classified according to age. The probable errors of the values of R. are given in the R. column, preceded by the sign $\pm$. The MV.'s for the R.'s only are given.

TABLE II.

Average Total Numbers of Letters Seen for Different Ages.

N.	AGE.	S.	R.	MV.	MAX.	MIN.	$\frac{R}{S}$
39	7 - 9	11	$4 \pm .4$	3	33	0	.4
77	10 - 12	20	$13 \pm .3$	3	32	0	.6
73	13 - 15	24	$18 \pm .6$	6	37	0	.7
132	16[1] +	32	$27 \pm .4$	6	59	8	.8

[1]Most of these observers were from 16 to 18 years of age.

From the above tables it is evident that the extensive threshold, or ability to receive and retain[1] a number of simultaneous, retinal impressions, is a function of individual growth, reaching its maximum only when the observer is fully developed.[2] The average number seen correctly in one trial by the adult observers was about three, whereas children from 7 to 9 saw but one. These numbers would be less if the element of chance were eliminated.[3] They would, on the other hand, probably be somewhat greater under more favorable conditions. In my experiments the observers did not know just when to expect the exposure, and, moreover, we must not expect such experiments to give results as exact as those of the laboratory. Practice increases the extensive threshold, and, as is shown by the columns MV. MAX. and MIN., great individual variations were observed. Very few adult observers saw five letters on the average, and some adults saw but two. The tendency to guess seems to decrease with maturity. The average mean variations of the separate observations of the individual observers from their averages were found to be about the same for the younger as for the older students. But the relative variation ($\frac{m v}{R}$) for the children of 10 to 12 was found to be about double that of the students of 16 and over. This is what we should expect, as it is a matter of common observation that children are deficient in power of constant attention.

A question of considerable interest is the relation of the pupil's range of perception to his intellectual capacity as judged by his teacher. I found that those rated A for mental capacity by the teachers, on an A, B, C basis, had somewhat higher averages than the others, and out of the twelve best observers (four from each age group) eight were rated A and but one C. There are, however, marked exceptions. One young lady of 18, known by the writer to be a brilliant student, saw but sixteen letters out of the sixty, and in no case more than three. Those marked A by their teachers for attention in class also excelled the others, but here also I found decided exceptions. Many pupils must have, therefore, good powers of attention even when they show no evidence of them to their teachers. No difference was found between

[1] I will use this expression hereafter in the sense in which it is here used, without making any assumption as to its psychological interpretation.

[2] The same result for auditory memory and attention was found by Bolton. AMERICAN JOURNAL OF PSYCHOLOGY, Vol IV, No. 3.

[3] The probability of correctly guessing any one letter was for the older students about one third of the probability of writing down a letter correctly as found in the experiments, and for the younger students somewhat greater.

the girls and boys, the averages closely corresponding. Other investigators have found that the girls tend slightly to excel the boys in the tests given.[1] More extended experiments might, however, show a difference.

In order to investigate the question of fatigue, the averages were taken for each of the ten experiments for each group. The results for the experiments in which long times of waiting were used, one to four minutes, were somewhat better than those in which short times were used. This was found for both series of times, $\frac{1}{3}$, 3, 1, 4 and 2 minutes, and $\frac{1}{10}$, 1, $\frac{1}{2}$, $1\frac{1}{2}$ and $\frac{1}{4}$ minutes.

But fatigue of the visual centres must have been present, since several observers complained of pain in the eyes and even headache from the strain of attention. As the results were not appreciably affected, we conclude that the attention of children may be taxed to the extent of causing abnormal fatigue without any marked effect on the accuracy of perception. As it is, moreover, improbable that the long periods of waiting are more favorable for perception, or at least so much so as is indicated, we must infer that, despite precautions to avoid this, there are decided differences in the legibility of the different groups of letters. Practice cannot account for the results for experiments V and VI, the accuracy of observation for V being about 30% and 40% greater than for VI for the two time series. Nor can we ascribe the greater legibility of V to the difference in fatigue, for, on the one hand, in the case of the H. M. S. observers, the time of waiting for V was much longer than for VI; on the other, in the case of the college students and some others, the times for both were very short.[2] We infer, then, that one determining factor is the arrangement of the letters. But in neither case was a syllabic combination used, and the combinations of threes certainly do not make "sense." On the other hand, YZB and CTP, the letters used for VI, have much less similarity to combinations of letters in actual use than have DRK and LSI, those used in V. If this be the explanation, the combinations are perceived as units rather than as separate and distinct objects; or at least the mind tends to perceive them so, and is successful in proportion to the ease with which the perceptive processes of the separate letters are mutually helpful. From this it would follow that we do not, as has been supposed, see several things at once, but see the given stimuli as a unit and then analyze this unit

[1] Bolton, *op. cit.* Jastrow, *Educational Review*, Dec., 1891.

[2] The same result was found for three private school groups not here included, as the times were not the same.

into its components. It is indeed possible that since the legibility of the letters depends upon the distinctness of the retinal images, some combinations of letters may not be so favorable as others for the formation of distinct retinal images of the different letters. It is interesting to note that in other experiments in which fatigue could play but a small part, the relation of V and VI was the same as in these.[1]

In the experiments described above, although verbal and syllabic combinations were avoided, several observers perceived certain combinations as words. Thus TSX LFA was read TEXAS, three times; OBP UJM was read JUMP, once; YOG LNA was read LONG, once, LONG WAY, once, and YOU, once; and UJR ZWD was read ARE, once. In a very few instances more letters were written down than were actually given. Three observers perceived the group first given as ABC, etc., the first letters of the alphabet.

A limited number of experiments were made with the same time of exposure, but with this difference, that one letter was exposed instead of six. The letters were CRYSNIXOJA. The times of waiting were $\frac{1}{20}$, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$, and $\frac{1}{6}$ minutes for the first five, and the same for the second five. The test was made on twenty-three high school pupils and on sixteen pupils of grade II in the primary department of the H. M. S. In the 230 observations (10x23) of the high school pupils, only seven letters were written down incorrectly; and in the 160 observations of the primary class only twenty-eight were not rightly perceived. The results show that the inability of the younger children to perceive the letters when six are given is due, not merely to the brief period of exposure, but also to the complexity of the stimulus.

A few experiments were also made in which six colors were used instead of letters. As the results were approximately the same, we may conclude that the inferences based upon the tests with letters are valid for the perception of objects in general and not for letters only.

The experiments I have described were all made with $\frac{1}{10}$ second exposure. I will now describe other experiments in which the time of exposure was one second. These experiments were made only on classes I-VIII inclusive of the H. M. S. and a group of high school students. The same apparatus was used, but was of course adapted to the change of time. This was done by attaching a heavy weight *W* to a cord which ran over a friction pulley *P* and was attached to the drop screen *AB* (see Figure 1). When the screen was allowed to fall, its velocity, and consequently the time of exposure, was regulated

[1] See later experiments with one second exposure.

by the weight on the principle of Atwood's machine. The same combinations of letters were used as in the $\frac{1}{10}$ second experiments, but several months elapsed between the two series of experiments. The experiment was conducted in the same manner, but short times of waiting only were used, 5, 30, 15, 45 and 10 seconds, and the same repeated for the second 5 experiments.

In the following table, I give the results of these experiments. The letters mean the same as in table I.

TABLE III.

Average total numbers seen with 1 second exposure for different classes.

N.	C.	S.	MV.	R.	MV.	MAX.	MIN.	$\frac{R}{S}$
19	I	20	7	17	5	36	7	.85
17	II	30	5	26	4	38	20	.87
10	III	37	5	33	5	49	20	.89
20	IV	35	5	28	6	48	14	.77
15	V	40	7	36	6	43	25	.90
22	VI	44	6	38	5	54	28	.82
13	VII	51	8	44	8	58	29	.86
11	VIII	50	8	47	7	59	31	.94
10	High	59	2	55	6	60	40	.93

The results show that the range of perception for one second exposure also depends upon individual growth. The brighter students tend to excel in these as in the $\frac{1}{10}$ second tests. This was found by two distinct methods, as before. There does not seem, however, to be any close connection between the two tests. The best observers in the one second tests include many that had poor records in the previous tests. But temporary conditions would cause some variation in the same observer.

As in the $\frac{1}{10}$ second experiments, variations were found in the accuracy of perception for the different combinations of letters. As the times of waiting were very short and as close attention was not necessary in order not to miss the letters, these differences cannot be ascribed to fatigue.

The relative variation was found to be fairly constant and to be but little greater for the children of the primary classes in the

one second tests than for the high school and college students in the $\frac{1}{10}$ second tests. But the relative variation for the younger pupils is at the same time much less in the one second than in the $\frac{1}{10}$ second tests. This is what one might expect, since, when the time of exposure is as long as one second, continuous concentration of the attention is not necessary as in experiments in which short times of exposure are given.

I have up to this point endeavored to make no assumptions as to the interpretation of the experiments described. The simplest interpretation is that the extensive threshold measures the number of objects that can be simultaneously grasped by consciousness. It is probable, however, that the process is quite complex. In fact the results found for the different combinations do not favor so simple an interpretation. The accuracy of the result may depend upon the reproductive processes involved, and the analysis of the memory image. It is possible also that the sensitiveness of the retina is a determining factor.

Whatever be the exact nature of the mental process, it is certain that the accuracy of perception and reproduction will depend to some extent upon the attention. In fact Wundt identifies the extensive threshold with attention.[1] From this point of view the results of the $\frac{1}{10}$ second experiments would measure the capacity of the observers for concentrated attention. It is quite true that attention is necessary in order to see the letters, but the assumption that it is the only factor is unwarranted. The results of the experiments certainly are not favorable to such an interpretation. No decrease in the number of letters seen was found for the longest times of waiting, which were such as to cause decided fatigue. Then many bright students proved to be poor observers, and it is improbable that students that excelled in their studies would be deficient in their powers of attention. But even if we assume that the experiments measure the attention, they do not necessarily measure the *capacity* for attention. Those interested in the experiments and desiring to excel would attend more closely than others. It is possible that the general superiority of the brighter students may be due to these causes; for children of the most active minds would be most interested in novel experiences. But although we cannot assume that the average number of letters seen by an observer measures his powers of attention, the mean variation from the average of the numbers seen in the different experiments is presumably due, principally at least, to variations in the attention.

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[1] Wundt's expression is "the extent of apperception," *Grundzüge d. Phys. Psy.*, IV^te Aufl., II, 287.

With regard to the one second experiments, the conditions are more complex than in the others, but at the same time conform more closely to those of the perceptions of ordinary experience. The number of letters seen doubtless depends upon the degree of attention, but it also depends upon the readiness with which the attention is fixed, and the time of perception. The development of the visual memory may affect the results in both series of experiments. That there is a radical difference between the processes involved is made probable by the fact that some that excelled in one test did poorly in the other.

THE "RECOGNITION-THEORY" OF PERCEPTION.

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Paradoxically expressed, the theory under criticism asserts that to *cognize* is to *recognize; connaître* is *reconnaître; kennen* is *wiedererkennen*. Hence the name I give it—the Recognition-Theory of Perception. To be consistent, the supporters[1] of this theory can draw no distinction between perception and recognition, at least in kind. Light distinctions of grade there may be, but perception and recognition are one and the same thing; perception is recognition. First the statement of the theory, then the criticism.

The Theory.

"A simple process of re-cognition is involved in all cognition" (Sully). This process of cognition (perception) Sully accordingly designates "automatic assimilation or recogni-

[1] The supporters of this theory are truly legion, the chief one at present being probably Prof. Höffding. Among the many may be cited Empedocles and Democritus, "Like is known by like." Kant, K. d. r. V. (Kehrbach, §127), "Es sind drei subjective Erkenntnissquellen, worauf die Möglichkeit einer Erfahrung überhaupt und Erkenntniss der Gegenstände derselben beruht: *Sinn, Einbildungskraft* und *Apperception*. . . . Der *Sinn* stellt die Erscheinungen empirisch in der *Wahrnehmung* vor, die *Einbildungskraft* in der Association (und Reproduction), die *Apperception* in dem *empirischen Bewusstsein* der Identität dieser reproductiven Vorstellungen mit den Erscheinungen, dadurch sie gegeben waren, mithin in der *Recognition*." Herbart in his "Apperceptionslehre." J. S. Mill in his edition of "James Mill's Analysis," I, 112, 113. H. Spencer, "Princ. of Psych," I, 267, 270. Bain, "Senses and Intellect," 4th ed., 489. Sully, "The Human Mind," I, 181, 196. Wundt, "Logik," 2te Aufl., I, 17; "Physiol. Psychol.," II, 469. Ward, Ency. Brit., Art. Psych., pp. 52, 60; also articles in *Mind* on "Assimilation, etc." Höffding, "Psychologie im Umrisse" (2te deutsche Aufl.), 161 ff. Vierteljahrsschrift f. wiss. Philos., XIII, 425-458; XIV, 27-40. Wundt's "Studien," VIII, 86-96.

tion." "Such assimilation is automatic or 'unconscious' in the sense that there is no separate and distinct recalling of a past sensation, and clear awareness of the relation of the present sensation to its predecessors" ("Human Mind," I, 181). We are informed that, so considered, assimilation is the necessary pre-condition of all association, thus making the Law of Contiguity secondary to the Law of Similarity.

Helmholtz writes ("Zeitschrift f. Psych. und Physiol. der Sinnesorgane," Bd. VII, Heft 2, §88): "Man pflegt als *Anschauung* eine solche Enstehung von Vorstellungen zu bezeichnen, bei denen in bewusster Weise nur der sinnliche Eindruck percipirt wird und danach die Vorstellung des Objects in das Bewusstsein springt, ohne dass weitere Zwischenglieder des Vorstellungskreises zum Bewusstsein kommen." Exner (Entwurf zu einer physiol. Erkl., etc., §234) defines the sense impression in perception as "ein lebhafter Process, der in der Rinde stattfindet, der aber keinen eigentlich psychischen Character trägt." Helmholtz, in the second edition of his "Tonempfindungen," §101, writes: "Empfindungen nennen wir die Eindrücke auf unsere Sinne, insoferne sie uns als Zustände unseres Körpers (speciell unserer Nervenapparate) zum Bewusstsein kommen; Wahrnehmungen, insoferne wir uns aus ihnen die Vorstellung äusserer Objecte bilden." I may add here that we are not conscious of sensations as states of our body or of the nerve-apparatus. *Red* is obviously the sensation red, without any reference to the retina or any part of our body; moreover we are conscious of no process by which we form a presentation of external objects out of the sensations. It is false description and bad hypothesis.

Herbert Spencer goes still further and reduces all cases of association to the one law, viz., association by similarity, at the same time making every perception a case of the law of association by similarity. His perception-theory is, therefore, the recognition-theory. "Every relation, then, like every feeling, on being presented to consciousness, associates itself with like predecessors. Knowing a relation, as well as knowing a feeling, is the assimilation of it to its past kindred; and knowing it completely is the assimilation of it to past kindred exactly like it. . . . Hence results the so-called Law of Association by Contiguity. When we analyze it, contiguity resolves itself into likeness of relation in time, or in space, or in both" ("Princ. of Psych.," I, 267). "Thus the fundamental law of association of relations, like the fundamental law of association of feelings, is that each, at the moment of presentation, aggregates with its like in past experience. The act of recognition and the act of asso-

ciation are two aspects of the same act. And the implication is that, besides this law of association, there is no other" (Ib., 270).[1]

The full faith that should be in us is found in Bain: "In the perfect identity between a present and a past impression, the past is recovered and fused with the present, instantaneously and surely. So quick and unfaltering is the process that we lose sight of it altogether (!); we are scarcely made aware of the existence of a reproductive link of similarity in the chain of sequence. When I look at the full moon, I am instantly impressed with the state arising from all my former impressions of her disc added together" ("Senses and Intellect," 4th ed., 489).

Dewey adds his testimony ("Psych.," p. 180): "In perception past experiences are *wholly absorbed or lost* in the present. When we see a man we do not recognize that there are involved in this perception *all the other men* which we have seen, and that it is only through the *ideal* presence of these experiences in the present data that the latter signify to us a man. But such is the fact."

Wundt gives the following definition of assimilation, which process, according to his belief, takes place in perception: "An assimilation takes place, then, when a new presentation enters consciousness and renews or revives former presentations similar to it, and when these elements fuse to a single presentation. In this case we perceive nothing of the reproduction-process." See also "Physiol. Psych.," II, 469.

The principal exponent of this theory, however, is Höffding. He informs us that it is difficult to classify "immediate recognition," with which he identifies perception, since it is neither sensation nor idea (representation), and yet contains something of the character of both. It reminds us of the sensation, because it has for an object something present, while the idea is only a memory presentation (*Erinnerung*). "This middle position between sensation and idea, we can theoretically express by saying that in recognition both an idea as well as a sensation element is present. If we name the latter A, the former *a*, we can express recognition by (A+a) or $(\frac{A}{a})$, denoting by the brackets that we distinguish between the two elements (which in reality do not allow of being sep-

[1] *Vide* the misunderstanding in James' "Princ. of Psych," I, 257 and 259: "Mr. Herbert Spencer has still more recently tried to construct a psychology which ignores association by similarity." Spencer somewhere says: "Were it not that the steps can be recalled, it would seem absurd to say that when the reader takes in at a glance the sentence, 'This is true,' he not only classifies each word with the before known like words, but each letter with the before known like letters."

arated) only by means of abstraction. *It can be said, then, that in recognition an idea is contained in so far as the same condition works in recognition, which in other circumstances would have been able to have led to a recall of that which has been experienced as an independent idea.* The idea contained in this way in recognition we will call an *implicate (gebundene) idea*, in contradistinction to the *free* ideas which enter consciousness as independent members of the conscious content. Recognition can be also named a memory (*Erinnerung*), but, however, an *implicate memory*, because that which one remembers does not enter consciousness as a free idea. It can also be called an *implicate comparison*, since it (the recognition) arises through similarity of the present impression with a former one, distinguishing itself, however, from the proper free comparison by the fact of the members, which were joined together by means of similarity, not making themselves felt independently in consciousness." ("Psychologie," 2te deutsche Aufl., 161-166.) Again, on page 239, he says: "This principle (principle of identity, A = A) corresponds to recognition, which is the presupposition of all association."

Criticism of the Theory.

After having endeavored to give the theory fully, I shall endeavor to give my objections to it in as concise a manner as possible. Some of them are objections to the false description of the facts, some to impossibilities involved in the theory, some to the unnecessary fabrication of hypotheses, and others to the lack of explanation for certain facts.

1. *Perception is not, as stated, an act of memory.* When I look upon the sun, it is the sun to me and nothing more. I do not remember all or any of the former suns which I have seen. It is the sun at once to me, and if the name is expressed upon the sight of it, it is only a case of ordinary association by contiguity. In fact, is it not impossible to experience at the same moment of time the perception and the so-called memory-image of the same object? Who can do it? If I burn myself, I know it is hot without any reference whatever at the moment to former experiences of burning. Ask me at the moment of burning if it is to me a remembrance of former burnings, or if there is any reference to past burnings, and the answer will obviously be a strongly negative one. Ask the patient whose tooth is being pulled out if the pain is a past pain, or if it has any reference to a past pain. Absurd. It is all there in the present. It is an all *here* and *now*, and the fact ought to be obvious to everybody. Repeat or read the letters of the

alphabet consciously, and how many of us have the slightest remembrance of each letter as having been seen before? And yet it is asserted by these theorists that before each letter is known there must arise first the present sensuous impression of each letter, and secondly a revived idea or memory-image (*Erinnerung*) of each which "identifies," "recognizes," or "fuses" with the sensuous impression. After this identification, recognition, or fusion, each letter respectively is known. "To cognize is to recognize; *connaître* is *reconnaître*, and *kennen* is *wiedererkennen*." Each one can repeat or read the alphabet for himself and judge of the accuracy of the theory. Spencer himself says: "To ask a man whether he remembers that the sun shines, that fire burns, that iron is hard, would be a misuse of language" (I, 456), and yet Höffding and Spencer demand a memory-element in each perception.

Höffding also asserts that in his formula of perception ($\frac{A}{a}$), A represents the sense-impression of the object, and a the idea- or memory-presentation. He also says the principle of identity, $A = A$, corresponds to recognition ("Psychologie," p. 239). In the perception-formula, then, $a = A$, or is identical with A; but A is a sense-impression, therefore a is a sense-impression. Again, if they are identical, how are we to distinguish the one as a sense-impression and the other as a memory-presentation, or how are we to distinguish them at all?

Lotze says ("Metaphysik," §265): "One would not be able to know anything at all of this fact, viz., of the reproduction of a former a by the present a, if both of them were simply indistinguishable and at the same moment of time there; in order to judge of the present one as repetition of the former one, we must be in a position to distinguish them both."

Later, however, we shall learn from their own admissions that this memory element (call it *implicate* or what you will) is *unconscious*, a matter belonging to the subterranean workings of that which lies under the threshold of consciousness. If unconscious, then for us obviously it does not exist as a conscious or mental fact. To say that certain phenomena (*e. g.*, this memory-element or these two "fusing ideas") are in consciousness at a certain given moment only *theoretically* (Höffding), *metaphorically* (Wundt), *abstractedly* (Höffding), or *ideally* (Dewey), is to say that they are *not* there, is to say that "the *process is lost sight of altogether*" (Bain), or that the phenomena are *unconscious* (*i. e.*, non-existent), as Höffding, Wundt and others distinctly assert. Yet the implicit understanding amongst these writers is that the phenomena in question *are* there in consciousness.

2. *Perception does not, as stated, involve comparison.* Again, an appeal to consciousness amply justifies this objection. When I perceive the table before me, I do not compare the table with any idea of the table seen in past experiences; although, *after* having perceived it, another image of it may arise by association and the two may by compared. The table must obviously, however, be first perceived. It is, however, only "an implicate *(gebundene)* comparison" which is said to take place between the two elements. The two members in "free comparison" are conscious; in this elementary comparison on the contrary *unconscious.*[1]

Wundt ("Logik," I, 17) informs us that in reference to the reproduction or recall of the memory-idea by the sense-impression, we perceive nothing of it. Consequently we perceive nothing of the comparison. Bain says ("Senses," 489): "In the perfect identity between a present and a past impression, the past is recovered and fused with the present, instantaneously and surely. So quick and unfaltering is the process that we lose sight of it altogether (!)." Sully ("The Human Mind," I, 181): "Such assimilation is automatic or unconscious," etc. Categorical enough are the statements and amazing the self-satisfied knowledge of the unconscious. I can assert just as well the opposite of what these writers affirm of the unconscious and it would exercise all the subtlety and keenness of a mediæval scholastic, not to mention that of Messrs. Höffding, Wundt, etc., to disprove my statements. More, their statements of an unconscious conscious act are too obviously impossible to demand refutation.

We are also informed that this act of perception (= recognition or *Wiedererkennen*) is an act of association by similarity. The sense-impression calls up by association by similarity the similar idea of the same object. Moreover, Höffding calmly informs us that this is also an act of *comparison.* "*It can also be called an implicate comparison, since it arises through similarity of the present impression with a former one.*" Let us suppose A, the sense-impression, to be present in consciousness, the problem is, how is a, the similar idea, to be brought there by comparison? Comparison, manifestly, presupposes the presence of the two before it can exist at all. Comparison with only one thing to be compared is worse than a distinction without a difference.

Again, supposing the comparison to be made after the two have arrived in consciousness, what is the need of a comparison if A, the sense-impression, is the object perceived, and

[1] "Viertel. f. wiss. Philos.," XIV, §198.

a, the idea, is only another former impression of the object? How can, or why should, *a* identify, recognize, or fuse with *A* when *A* is just as much the object perceived as *a*, and why the comparison? F. H. Bradley ("Principles of Logic," chap. Association of Ideas) gives some excellent criticism on the untenability of the view that association by similarity can be brought about by comparison.

The discussion is much shortened, however, by the fact that the comparison is said to take place unconsciously.[1] It is still further shortened by Höffding's statements that the sense-impression *A* and the idea *a* (which?) are *contemporaneous*, *different*, *indistinguishable*, *identical*, and, to put the corner-stone on, *unconscious*.

3. *Perception does not involve the so-called process of "psychical chemistry."* The two elements *A* and *a* are said to "fuse" into one indistinguishable whole. "There is here accordingly an activity displayed, *the result of which* presents itself to consciousness, although it itself was exercised unconsciously."[2] The two elements are said to be only "*theoretically*" (not as a matter of fact?) present in consciousness. We are said to distinguish between them "only by means of abstraction."[3] And Wundt knows nothing of the act of reproduction in the act of assimilation and perception; but nevertheless affirms that the two elements fuse *(verschmelzen)* to a single presentation ("Logik," I, 17). He says ("Physiol. Psych."), moreover, that the word "union" *(Verbindung)* has a "metaphorical" meaning.

If it be dark and mysterious to those initiated into the hidden secrets of the unconscious, what must it be to the uninitiated? What is in consciousness is surely a matter of fact, and not "theoretically" or "metaphorically" there. And how two unconscious ideas fuse, identify, recognize and compare each other in the unconscious and produce a totally new result is to me unaccountable. (*Vide* Stumpf's criticism of Hartley's and J. S. Mill's doctrine of "psychical chemistry," "Ursprung der Raumvorstellung.)" James[4]: "Moreover, if feelings can mix into a *tertium quid*, why do we not take a feeling of greenness and a feeling of redness and make a feeling of yellowness out of them? Why has optics neglected the open road to truth, and wasted centuries in disputing about theories of color composition which two minutes of introspection could have settled forever?"

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[1] *Vide* Dewey, "Psychology," p. 180; Höffding, "Viertel. f. wiss. Philos.," XIV, 198.
[2] Höffding, "Viertel. f. wiss. Philos.," XIV, 198.
[3] Ib., "Psychologie," §165.
[4] "Principles," I, 157.

4. *In perception there is no "reviving" of former impressions.* The idea *a*, even if there should be one in perception, is not any one of the former sense-impressions of the object perceived. Few there are who nowadays believe that our former sense-impressions lie thick as ghostly bones in the tomb below the threshold of consciousness, waiting only some breath of life to raise them above the threshold as still ghostly images of their former selves. According to Höffding and a few others, the river Styx must be full of these ghostly wanderers. "Revive," "recall," "resurrect," "reproduce," "reawaken" are words used too often as shoddy explanations of the process in question.

Moreover, which of the many predecessors of the present sense-impression is the one "revived" and "reproduced," granting that such a "revival" were possible? Is there some particular former impression always on hand ready for the work of identification and recognition? Moreover, what a huge mysterious problem these authors have to solve in this doctrine of the preservation and reproduction of ideas! It is simply astonishing to me that nobody has raised any objections to Ward's solution, or rather description of these phenomena in his doctrine of the *Continuum* (Ency. Brit., Art. Psych.). He denies the usual statement that our ideas pass out of consciousness and are again reproduced as images of their former selves. But an upholder of the old theory might ask, what becomes of all our former thoughts and knowledge, where are they now? Ward answers that they are all in consciousness still, only "subconsciously." Our whole mental life, according to him, forms a *continuum*, in which all the past is, along with the present, in consciousness. The present is only more prominently there, the past, with all its thoughts, feelings, etc., is there also, but *subconsciously*. Hence there is no problem of reproduction of ideas. By "subconscious" Dr. Ward does not mean unconscious, but rather some degree or measure of consciousness. The whole doctrine, for me at least, is amply refuted by the fact that it is purely and absolutely a false description of the facts. I am conscious neither subconsciously, unconsciously nor consciously at the present moment of time of the vast majority of my former mental experiences. As far as my present consciousness goes, they are absolutely non-existent.

But to return to the more immediate problem, does consciousness say that the "reproduced former idea" recognizes the present sense-impression, or that the present sense-impression recognizes the former reproduced idea? Not at all. Plain, unvarnished, unprejudiced consciousness says in perception, "This is object so-and-so," and in recognition

proper, "This is object so-and-so again." Of the "recognition" and "identification" of the present sense-impression *A* by the "reproduced memory-image" *a*, there is never a sign.[1] Moreover, how can the presentation *Object A* recognize or identify another mental presentation *Object a?* Consciousness, in fact, says nothing of the two presentations being there in perception at all. It is simply *Object A*.

Prof. Höffding says, "*Under other circumstances*" the idea-element in perception could be recalled as an independent idea ("Psych.," 166); *i. e.*, I might say, if it had not been as it actually is, it might have been otherwise; or, in other words, if it had not been a single, indivisible idea, there might have been two. He thereby admits that there is only *one* presentation there, and that the other is a fiction. Observation shows the fact that there is only one presentation there in perception. Then, "*tant pis pour les faits*" Prof. Höffding may answer along with the speculative Frenchman; they must be there *unconsciously*. In the world of science, he who finds his hypothesis at variance with large parts of the evidence forthwith abandons it; even in ordinary life a man whose supposition proves to be flatly contradicted by observation is expected to hesitate. Prof. Höffding has ever, however, his City of Refuge—the Unconscious.

5. *There is an unwarrantable extension of the term "recognition" to perception.* There is a class of phenomena which Prof. Höffding has remarked, a class which is really what we all call recognition. This class he has designated "immediate recognition," and rightly so. The extension, however, of this designation to the whole field of perception is quite unjustifiable.

We have often a very strong conviction of having been before in the same place or in the same circumstances as those of the present presentation, but, nevertheless, can recall no other circumstances which confirm the conviction. The places or circumstances appear perfectly familiar, though we know we have never seen them before. They appear, as we generally say, *known* to us. As Höffding says, "A single trait of a countenance, a color-tint of the sky, an accidentally heard word can appear to us as known (*bekannt*) without us being able or even without us feeling the need of referring them to definite former occurrences. They appear to us differently from perfectly new sensations." This peculiar feeling of *knownness* he calls the *Bekanntheitsqualität*.

This feeling of strange familiarity is, however, character-

[1] Cf. Bourdons, "La Reconnaissance de phenom. nouveaux," *Rev. Philos.*, 36, p. 630, and A. Lalande, "Sur les paramnesias," Ib. 36, 485-497.

istic of only a very small class of phenomena. That is why they are called *strange*. Everyone knows, however, that this feeling of strange familiarity does not characterize all our perceptions. If so, then why the *strangeness*, the wonder and the curiosity which are aroused when the phenomena actually do occur? Höffding has quite unwarrantably, however, extended the designation of this class of phenomena to the whole field of perception. Our perceptions are not all accompanied by this characteristic of strange familiarity or knownness. Moreover, these special cases of familiarity are cases of perception + recognition, as will be explained in a succeeding essay. If so, it is doubly false to say that perception *is* recognition, *Kennen Wiedererkennen*, etc.

6. *The cause of the Bekanntheitsqualität is incorrectly given.* Höffding draws a distinction between "old sensations" (*alte Empfindungen*) and "new sensations" (*neue Empfindungen*). The "old sensations" are apparently those which we have had before, which can be "revived" and "reproduced." These sensations have been repeated. On the physiological side there has been repeated practice. The movements, whatever they may be, take place more readily, with less expense of effort and strain than they did at first. Consequence—there appears on the psychical side a corresponding change, viz., the quality of knownness or the *Bekanntheitsqualität*, which is apparently of an elementary, irreducible kind. Old sensations, when accompanied by this feeling, this *Bekanntheitsqualität*, are known, even thereby do they appear as *old* or *known*.

The "new sensations," on the other hand, according to Höffding, do not possess this quality of knownness. If they did, we could not distinguish between the old and the new sensations.

But what are these "new sensations"? Firstly, they may mean sensations which we never had before—sensations of a new sense, to which we have not yet developed. Or they may mean the first sensations which we ever had at the beginnings of our lives. Secondly, Höffding means by "new sensations," although he does not notice the confusion, the fresh, vivid sense-impressions in contradistinction to the revived faint images of former impressions. The one class is old, faint, ghostly; the other fresh, new. The fresh, vivid and present sense-impression is a new creation in comparison with the revived image of the old, which is only a reproduction and not a fresh creation.

The fatal point for this plausible doctrine is that *these sense-impressions, these "new sensations" of the second class demand, on the physiological side, just as much practice*

and repetition as the so-called "old sensations," and therefore should possess just as much the Bekanntheitsqualität as the "old sensations." The sense-impression *red* has, in all probability, the same nervous concomitant processes as the image red; in both the nerve processes have had very extensive practice and repetition, the one as much as the other. Hence, the sense-impression should have the *Bekanntheitsqualität* just as much as the image-element. In Höffding's perception formula $(\frac{a}{A})$ then, the sense-impression element A ought already to have the *Bekanntheitsqualität* before the so-called image-element a arrives, and ought to have it just as much as the other. If such be the case, Höffding's hypothesis of the image-element a contributing the knownness element is utterly useless.

The more probable explanation of this phenomenon of strange familiarity will be attempted in another essay.

7. Finally, *the theory utterly fails in its attempt to explain sense-illusions or what may be called abnormal perception.* In journeying upon a road in the deep twilight, I see the threatening figure of a robber with up-drawn, menacing arm. At the moment I am most certain and positive that it is a robber. For me, at the time, it is just like all my other perceptions, perfectly normal. Upon closer investigation, however, I perceive the objective figure to be in reality the stump of a tree with its gaunt, outstretched limb. Now I perceive that my first impression was abnormal, that it was a sense-illusion.

And now for the recognition-theory explanation: "The sense-illusion is a mistaken, partial perception. With $(\frac{a}{A})$ b and c unite themselves, although in this case they do not really belong with A. A mistaken interpretation of an objective impression takes place, as, *e. g.*, when a white towel in the moonshine is taken for a white figure, or wreckage on the coast for men." (Höffding, "Psych.," 197.)

To say that a sense-illusion is a mistaken perception is easy, but no explanation; to say it is a partial perception is partially false, and it gives no explanation at all *why I thought there was a robber there*, which is the essence of the matter. The formula given by Höffding is false to the facts,—it runs $(\frac{a}{A}) + b + c$. If A represents the stump of the tree, then $(\frac{a}{A})$ means that the stump of the tree is perceived as such, which is absolutely contrary to the facts. If I had perceived the stump of the tree, it would have been no sense-illusion; but I did not perceive the tree. It was a robber. The formula, therefore, gives a false description of the facts, and, moreover, provides no explanation of the fact that another presentation or perception, viz., the robber, arises. In fact, the

theory is again at fault in its description, for in the sense-illusion there was no *second* perception, viz., the thought or perception of the robber. That was the first and only perception. The perception of the tree stump came *later*, not as in the formula first, and then we knew that the first perception (the robber) was an illusion.

Granting even that we perceive the tree stump ($\frac{a}{A}$) first, which of course we do not, why should $b + c$, the thought of the robber, arise? The recognition-theory formula gives no explanation whatever.

Let us, however, suppose that in ($\frac{a}{A}$) $+ b + c$, A means the dark outline of the tree stump and $+ b + c$ the perception of the robber. Again it would be a false description of the facts.

We do not perceive a dark outline and then have the second thought of a robber. The robber is the first and only perception. Moreover, in the quick flash of the perception, who would be aware of the recognition process involved in ($\frac{a}{A}$), viz., the sense-impression A, the calling up by association through similarity (comparison also!) of the "memory image" a, the identification, recognition and fusion of the two and the birth of the new product by psychical chemistry (which is neither a nor A!)? All these processes would presumably produce the perception of the dark outline of the tree stump. This, however, we do not perceive ; it is, rather, a robber.

But why pursue the investigation further? Any one of the above objections ought to make us hesitate before ever again giving countenance to this old, traditional theory, which has ruled the psychological world since the days of Democritus and Empedocles.

RECOGNITION.

By Arthur Allin, M. A., Ph. D.

1. The Strange Feeling of Familiarity.

Sir Walter Scott in "Guy Mannering" writes: "How often do we find ourselves in society, which we have never before met, and yet feel impressed with a mysterious, ill-defined consciousness that neither the scene nor the subject is entirely new; nay, we feel as if we could anticipate that part of the conversation that has not yet taken place." Oliver Wendell Holmes in the "Autocrat of the Breakfast Table" (p. 103) also writes: "All at once a conviction flashes through us that we have been in the same precise circumstances as at the present instant, once or many times before." Shadworth Hodgson in "Time and Space" (p. 273) speaks of "another phenomenon of the very opposite to that of apparent novelty. It is when we have a strong feeling of the sameness of objects, or states of consciousness in redintegration with some object, or state of consciousness which has preceded, but what or where we cannot remember. I allude to cases of dreams and, more rarely, of waking perceptions, where we have a strong conviction of having been before in the same place or the same circumstances as those of the present presentation or representation, but nevertheless can recall no other circumstances which confirm the conviction. Sometimes we dream of a place which appears perfectly familiar; sometimes we see a place waking, which appears familiar, though we know we have not seen it before, and then, perplexed, say we must have seen it in a dream. Here are cases of *an inexplicable sense of familiarity and recognition*, obtaining in dreams, in waking, or in cases which perhaps consist of both. It seems to me probable that this sense of familiarity depends on the rousing of the same particular feeling of interest by two or more different perceptions; and that, from the identity of the interest, we infer the identity of the objects of presentation or representation."

Charles Dickens in "David Copperfield" and in "Martin Chuzzlewit"; Tennyson in "Two Voices," "Early Sonnets,"

and "The Princess"; Thomas Hardy in "A Pair of Blue Eyes"; Edward Dowden, Pierre Loti, Lowell, and many others, have all borne testimony to the same experience.

> "I have been here before,
> But when or how I cannot tell:
> I know the grass beyond the door,
> The keen, sweet smell,
> The sighing sound, the lights around the shore."

So Rossetti in "Sudden Light," and

> "You have been mine before—
> How long ago I may not know:
> But just when at that swallow's soar
> Your neck turned so,
> Some veil did fall—I know it all of yore."

One recalls at once Wordsworth's "Our birth is but a sleep and a forgetting," "not in entire forgetfulness," and "those shadowy recollections."

Persons of a poetical, mystical and speculative nature speak of these experiences as "vestiges of a previous state of existence, as an echo from a life anterior to the present one." Plato's doctrine of "reminiscence" and immortality has probably a psychological basis in this strange feeling of familiarity. Coleridge writes: "And some have said we lived ere yet this robe of flesh we wore." One writer speaks of these "convictions of metempsychosis difficult to shake off."

Sir James Crichton-Browne, M. D.,[1] regards these experiences "not as intimations of immortality, but as revivals of hereditarily transmitted or acquired states in new and special combinations." They have been enthusiastically described as "indescribable" and "transcending all common experience," as "excursions into that infinite field that lies behind appearances, and of which it is dangerous to affirm or deny anything. Plunges they are into these depths of outer mystery in which the certitudes of faith arise. Momentary realizations they become of Nirvana, or the cessation of being, or foretastes of purgatorial pains more scorching than any that Dante conceived."

Again, these phenomena occur in circumstances the most commonplace and trivial, as in blacking boots, picking up a pin, etc.

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[1] *Lancet*, July 6th and 13th, 1895. MM. Dugas, Lalande, and van Biervliet (*Rev. Philos.*, 1893 and 1894) in their discussions on this subject give many other interesting cases well worthy of being noted. Their explanations are, however, hardly on a par with their examples. *Vide*, also, "Sulla paramnesia, o falsa memoria." Nota del Prof. Tito Vignoli (*Rendiconti del R. Istituto Lombardo*, 1894). Prof. Burnham in AMERICAN JOURNAL OF PSYCHOLOGY, Vol. II, gives many cases and much bibliography on the subject of paramnesia.

Some account for these phenomena by Wigan's doctrine of the brain's being a double organ, its hemispheres working together like the two eyes. One of the hemispheres hangs fire, they suppose, and the small interval between the perceptions of the nimble and the sluggish half seems an indefinitely long period, and therefore the second perception appears to be the copy of another, ever so old—manifestly a doctrine not much better than the scholastic one. "*Memoriæ sedes, ac velut fabrica, in occipitio est a natura collocata, admirabili sapientia, quod præterita cernat.*"

M. Lalande explains these phenomena as due to a moment of absence, followed by a brusque awakening of the attention: one perceives without apperceiving; upon this sensation becoming an object of apperception, the phenomenon in question arises. The sensation is met and recognized by its memory-presentation (*se souvenir surgit des ténèbres de l'inconscient, et il dissipe ces ténèbres*). These two mental presentations associate with each other without being able to fuse; hence a memory-presentation which produces the effect of a perception and a perception which produces the effect of a memory-presentation.[1]

Wigan ("Duality of the Mind," 1844, pp. 84-5) speaks as follows on this subject: "Sir Walter Scott calls this mental phenomenon 'a sentiment of pre-existence.' It is a sudden feeling, as if the scene we have just witnessed (although from the nature of things it could never have been seen before) had been present to our eyes on a former occasion, when the very same speakers, seated in the very same positions, uttered the same sentiments, in the same words — the postures, the expression of countenance, the gestures, the tone of voice, all seem to be *remembered*, and to be now attracting attention for the second time. *Never* is it supposed to be the third time."[2]

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[1] M. Lalande admits also a *telepathic* sense, perceiving in advance facts which one would not fail to *recognize*, when they fell afterwards under the ordinary senses. M. Dugas "in order to escape the humiliation" of resting short without a decent hypothesis, suggests that "false memory is a very special case of the doubling of the personality!" But how and why should this doubling of the personality take place? "Perhaps," he says, "in consequence of a spontaneous self-hypnotization!"

[2] Höffding in his *Psychologie* and in other articles notices these peculiar phenomena and calls them "immediate recognition"; he, however, most unwarrantably, extends this designation *to all cases of perception*, although it is perfectly manifest that all cases of perception do not have this strange feeling of familiarity attaching to them. It is just on account of the scarcity of the phenomena that we add the epithet "strange." Höffding writes: "An individual trait of a countenance, a color tone of the sky, an accidentally

Now this delusion occurs only when the mind has been exhausted by excitement, or is from indigestion, or any other cause, languid, and only slightly attentive to the conversation. The persuasion of the scene, being a repetition, comes on when the attention has been roused by some accidental circumstance, and we become, as the phrase is, wide awake. . . . "I have often noticed this in children, and believe they have sometimes been punished for the involuntary error, in the belief that they had been guilty of deliberate falsehood."

This is the phenomenon of *strange familiarity* which has to be explained. It plainly includes *perception* + *the feeling of strange familiarity*. This Höffding calls "immediate recognition," and extends the designation to all cases of perception, asserting therefore that in each case of perception we have perception + the feeling of strange familiarity. And if the feeling of strange familiarity is the recognition-element, then Höffding is certainly not correct in saying that *perception alone is recognition*.

This phenomenon has to be explained and also the somewhat frequent phenomena of recognition in general, *i. e.*, of *object-known-againness*. Certain phenomena, however, generally asserted to be memory and recognition, must first be shown to be no memory or recognition.

2. *"Half-dream conditions," dreams, imagination, in short, all centrally excited presentations are not thereby phenomena of memory and recognition.*

"Half-dream conditions" are the *Halbtraumzustände* of the Germans, and are the object of frequent references in the

heard word can appear to us as known (*bekannt* = known again or recognized, with Höffding), without our being able or even without our feeling the need of referring them to definite former occurrences. They appear to us differently from perfectly new sensations. They have a different stamp. It is the same when we are not able to call back a name in memory, while we are at once absolutely sure that this was the one meant upon its being named. Here, also, the recognition is immediate; the name sounds to us as immediately known (*bekannt*). The difference between that which appears to us as known, familiar, home-like, and that which appears to us as new and unknown, cannot be described more nearly. This difference is given just as simply and immediately as the difference between red and yellow, or between pleasure and pain. Repeated sensations can present themselves to us with a peculiar quality, which one could name the *quality of knownness* (recognition) (*Qualität der Bekanntheit*) as the opposite of the *quality of strangeness*" (S. 163). It is hardly needful to point out the confusion of thought which Höffding labors under in the use of the word "*bekannt.*" Because we know or are acquainted with an object, we do not necessarily have the subjective experience of *object-known-againness*. An object known with "the quality of strangeness" ought to be, if these psychologists were consequent in their thinking, a contradiction in itself.

psychiatries. Krafft-Ebing names them *Dämmerzustände*. Epileptics show quite a tendency to fall into this state. Fatigue induces it in many cases. Unwonted strain in unwonted surroundings is often the inducing cause. Their usual circle or world of ideas vanishes, or rather changes, and the subjects live, so to speak, in a different world. Such persons, if at a long distance from home and if subject to a strange and new set of conditions (homesickness), are apt to be subject to these attacks. Young soldiers, without any premeditation, attacked by these "half-dream states," visit their far-off homes, and in terror awake from this condition far from their garrison town.[1] Westphal describes this as a condition in which consciousness can be deeply disturbed, and in such a way that the person concerned moves in a world of ideas which appears separated or loosed from his normal one. Acting in accordance with this abnormal circle of ideas (with their concomitant feelings and will-movements), he performs acts which are completely foreign to the usual content of his thinking, and which have no relation at all to it. Nevertheless coherent and, up to a certain point, consequent action remains intact, all being in accordance with the prevailing set of ideas.

The causal mechanism of these half-dream states one may construe after the analogy of dreams, in which the ideas of the day time, involving strained and fatiguing exercise of the cortical centres, are replaced by unusual ideas,—ideas, the objects of which were experienced in a far away, more remote time. Students in a foreign land are apt to experience this during the first few weeks of their sojourn. It is homesickness. The new surroundings fail of associations and interest; it is strain and tension to attend to them. The world lived in is the old world, the home world. In lying down upon the sofa during the day for a rest, the same phenomenon occurs. The cortex during the day has been in a severe state of *tension*. The activity has been prolonged and great, the strain unceasing. Rest comes at the end of the labor. The muscular strain is relaxed. The waste products of the system, which clogged and delayed the reparative process, have now freer and more unimpeded channels. All function is less restrained and follows the line of least resistance. It is easier for the nervous impulses to slide into the old paths than to attempt to scale the heights, or pioneer in comparatively new and untrodden paths. The new associations formed during the day, or at least quite recently, involved much pioneering, strain and nervous exhaustion; this, however, gives way after the tension is

[1] Meynert, "Klinische Vorlesungen über Psychiatrie," S. 81.

over. The old-established and oft-repeated associations have now the right of way. As in financial crises, the "old-established houses" almost always weather the gale; the new houses go to the wall. Their "connections" are at different stages of growth. When falling asleep and immediately afterward reawakening, we find, usually, not the events of the day, but those of far-off experiences to be the subjects of our dreams. Even in lying down on a sofa for a complete rest, the same phenomena occur. In cases of general break-up, when the strong nervous organization of the brain begins to fail, general names remain the longest.

If those phenomena usually designated "will" have their physiological correlate, not in any one definite locality of the cortex, but rather in each presentation centre, then we may more easily understand how it is that the movements and actions of the patient are connected with, or flow from, the presentation centres actually prevailing.

Ross, in his "Diseases of the Nervous System," says (p. 137): "Experiments on animals have shown that a nerve whose nutrition is lowered, discharges its energy more readily than one whose nutrition is perfect, and similarly when the nutrition of the *sensorium commune* is defective, it responds to stimuli of less intensity than when its nutrition is normal." "The depressing emotions, such as fear and anger, are also liable to become excessive during states of nervous exhaustion, and it is a matter of common observation that a person who is in feeble health is often very irascible, while others are easily excited to laughter or tears." "When the inhibitory action of the highest or higher coördinating centres is removed, the functional activity of the lower centres may be increased. Many atrocious murders are said to have been committed during the period of semi-consciousness which sometimes follows an epileptic seizure. . . . It is probable that in delirium the stock of irritable matter in the gray substance of the cortex is much exhausted, and that what remains manifests an undue degree of irritability, so that the protoplasm gives out energy either spontaneously or on the application of slight stimuli, while functionally there is a dissolution from the later to the earlier acquired feelings and experiences."[1]

It is during these fatigued states that strange and unlooked-

[1] Holmes somewhere says: "The seat of the will seems to vary with the organ through which it is manifested; to transport itself to different parts of the brain, as we may wish to recall a picture, a phrase, or a melody; to throw its force on the muscles, or the intellectual processes. Like the general-in-chief, its place is everywhere in the field of action."

for associations occur, thus giving rise often to some of those cases of strange familiarity cited above.

These states of half-dreaming, dreaming and imagination are not memory or recognition proper. There is no reference whatever to the past. They are what may be called *object-consciousness*. And if time enters into these phenomena it is a present time. The dreams of savages are often asserted to be for them real, as if they were not so for us also. The only difference lies in the after-thought of those dreams. To both they are real during the dream. So with illusions and hallucinations. *During these states*, the objects are regarded as objectively present, just as much as in the every-day normal perceptual world.

We thus attain to two classes of phenomena, the *peripherally excited* and the *centrally excited*. The latter class has generally been called *memory*, but quite wrongly so. There is absolutely no reference to the past whatever in them, of themselves. It is an additional process, that of memory and recognition. With the exception of the element of *reproduction* in his teaching, Christian Wolf saw clearly some truth in this matter. He writes, "Psychologia Empirica," §176: "*Facultas ideas, quæ antea habuimus, reproducendi, non pertinet ad memoriam*," and "*Facultas producendi perceptiones rerum sensibilium absentium Facultas imaginandi seu Imaginatio appellatur*," §92. Note the *definition* he gives and the *example*, "*Ideam reproductam recognoscere dicimur, quando nobis conscii sumus, nos* EAM *jam antea habuisse. Videmus hominem in templo alibi jam ante visum. Dum eum intuemur, conscii nobis sumus, nos* EUM *jam ante vidisse*," §93.

To say that memory and recognition is explained by the *reproduction of former experiences*, which would be simply the former perceptions, present, fresh, etc., is to give an explanation precisely on a par with that of the scholastic quoted above. "*Memoriæ sedes, ac velut fabrica, in occipitio est a natura collocata, admirabili sapientia, quod præterita cernat.*"

The lonely traveler actually sees a robber with outstretched arm in the gathering twilight. He *sees* the robber, and it is to him a robber. It is a full and complete perception of a robber — for him. But the external object is the stump of a tree with a gaunt, outstretched limb. There are then in this perception certain elements of the perception *centrally excited*. They were not, however, on that account memories or memory pictures (*Erinnerungsbilder*). They were like the sense-impressions; in fact, they *were* sense-impressions. Manifestly, centrally excited presentations are not on that

account memories; though memory is often thus explained, viz., as the reproduction of former impressions.

It may be argued that the centrally excited presentations cannot be explained otherwise than as reproductions of former sense-impressions. But if the sense-impressions are regarded as new creations, so also may the centrally excited ones. Carpenter puts forward the probable causal mechanism on the physiological side in a very terse, concise form. He writes ("Mental Physiology," p. 440, 1891): "As the sensori-motor apparatus — the instrument of our *bodily* activity — appears to *grow to* the mode in which it is habitually exercised, so we seem justified in assuming that the same thing is true of the cerebrum, which is the instrument of our *mental* activity. . . . The material particles constituting this (nervous) system are continually changing, but, according to the laws of nutrition, the structure itself is kept up by re-position of *new* matter in the precise form of the old."

Wundt's definition of a memory-image (*Erinnerungsbild*) is hardly seaworthy. He writes: "We give the name of *Erinnerungsbilder*, or memory-images, to those reproduced ideas, which are so similar to certain former perceptions that they are referred directly to the same." Objections: Ideas are not "reproduced"; "certain former perceptions" are not now present, as stated in the definition; the similarity between the two is not a datum of consciousness; no comparison takes place between them; nor are the *Erinnerungsbilder*, or memory-images, referred directly or indirectly to the former perceptions, as consciousness asserts that the object is known again, not the former perception. Wundt classes together indiscriminately under the name of *Erinnerungsbilder* both centrally excited presentations and other presentations to which are attached the characteristic of "known-againness." Moreover, what can be meant when Wundt says, "The reproduced idea is referred to former impressions"? Is not, according to the definition, the "reproduced idea" the former impression? If it be the same, then how can the one be referred to the other? If it be not the same, then, when it is referred to former impressions, those impressions must be in consciousness at the time in order to be referred to. If they are in consciousness, then nothing is gained, for they are no longer the former impressions. What, also, does this "reference to former impressions" mean? Surely an essential point.

3. Assimilation or Association not Recognition.

Sully ("The Human Mind," I, 181) says: "A simple process of re-cognition is involved in all cognition," and

names this "automatic assimilation or recognition." Herbert Spencer writes: "Every relation, then, like every feeling, on being presented to consciousness, associates itself with like predecessors. Knowing a relation, as well as knowing a feeling, is the assimilation of it to its past kindred; and knowing it completely is the assimilation of it to past kindred exactly like it. . . . Thus the fundamental law of association of relations, like the fundamental law of association of feelings, is that each, at the moment of presentation, aggregates with its like in past experience. The act of recognition and the act of association are two aspects of the same act." ("Principles of Psychology," I, 267 and 270). Wundt identifies recognition with assimilation and defines assimilation as follows: "An assimilation takes place, then, when a new presentation enters consciousness, reproducing former presentations similar to it, and when these elements fuse to a single presentation. Of this reproduction process, we perceive in this case nothing." ("Logik," 2te Aufl. I, 17). One may also cite, besides many others, Höffding (*passim*), who makes perception also an assimilation and assimilation a recognition. For more lengthy quotations see article "The Recognition-Theory of Perception" in this number.

Dr. James Ward ("Assimilation and Association," *Mind*, 1893, p. 347) writes: "Nothing can be plainer than that association in strict propriety of language implies two or more distinguishable and distinct individuals; and is in this respect different from amalgamation or fusion, which both imply the merging of two or more bodies into a new complex and compound." Even granting that such an act as is described by these psychologists under the name of assimilation, fusion of similars or association may take place, *it seems, however, utterly impossible to get recognition or known-againness from such an association, fusion or assimilation. Objectively* considered, it may be a second cognition, and in this case a re-cognition, but subjectively it would be *for the percipient's consciousness* simply (Object + Object), becoming eventually fused into (Object), the parentheses signifying a unified act.

Moreover, if it were a case of *association*, then the two presentations associated must be separately cognized in order to be associated. The double cognition of an object will avail nothing. If each cognition is, in their language, however, a recognition, then each cognition will have to be explained by an infinite *regressus* of assimilations. In association the members associated remain distinct and separate after the act, in fusion, on the contrary, they are supposed to lose their separate identity in a new and different product. Granting what to

me is an impossibility, viz., mental fusion, there still remains the same impossibility of recognition or known-againness arising from such a fusion. Prof. Höffding naïvely admits that such a recognition or memory is "theoretical," "implicate" (*gebundene*), etc., thereby asserting that the phenomena are not actually there in consciousness. This "theoretical," "metaphorical" memory[1] reminds one of Cicero's dictum *re* the *quasi corpus* of the Epicurean god: "*Corpus quid sit intelligo: quasi corpus quid sit, nullo prorsus modo intelligo.*"

Nor, again, do collateral presentations (*Nebenvorstellungen*), however closely connected with the object cognized, explain the recognition or known-againness of that object. It is nothing to the point in this case, too, if these *Nebenvorstellungen* arise by the so-called processes of association by contiguity or by similarity. The *Nebenvorstellungen* are either a second presentation of the same object, which is, *subjectively*, no known-againness of the object; or they are presentations of some other objects, which is obviously again no known-againness of the first object; or they are emotional or feeling presentations, which also are no knowing-againness or known-againness of the first object. Lehmann, Offner and Ward, as well as many others, seem to be guilty of this mistake. Lehmann's articles are well known. Offner (*Zeitschrift f. Psychologie*, VIII, S. 146) says: "*Die Bekanntheitsqualität ist auf ein Hereinwirken sich nicht über die Schwelle erhebender durch Berührung assoziirter Nebenvorstellungen zurückzuführen.*" Ward in *Mind*, 1894, article "Assimilation and Association," II, p. 532, says: "The mere sense of familiarity or facility is, then, not strictly a re-cognition, or identification of present impression and past image, but a subjective state partly active, partly emotional." Ward also writes (*Ib.*, p. 527): "This earliest and purest assimilation thus briefly indicated, agrees, I believe, in the main with the theory of simple recognition which Höffding has discussed in such a fresh and lucid manner. What Höffding has specially called the *Bekanntheitsqualität* answers to the more subjective side of the process. This I ventured to suggest might be symbolized as $A\gamma$, $B\gamma$, etc., inasmuch as this quality is no part of the content of the presentation recognized, and is essentially the same for one presentation (A) as for another (B). It has been only incidentally referred to here, as

[1] Ward, *Mind*, 1894, p. 528: "Reproduction, like association, presupposes assimilation and not *vice versa*. Of course, strictly speaking, till we get beyond assimilation, the distinction of A and *a* is mainly an analytical distinction. The 'tied idea' has no free existence, and in actual apperception has no independent existence."

we were mainly concerned with the 'tied' or implicit idea symbolized by the small letter in Höffding's bracket ($\frac{a}{A}$). But it is important to note that both the γ and even this a come into existence through subject activity and interest, and are not produced solely by the primary impression or A. No doubt A is regarded as active in reviving or reproducing a, *i. e.*, on the associationist view; but here it is rather a that is active in apperceiving and appropriating A." In addition to the above remarks, I have tried in a preceding article to show that this "sense of familiarity or facility" arising, as they say, from practice, repetition and functional activity ought to accompany every sense-impression as well as the so-called ideas, for *both* demand the same amount of practice, repetition and functional activity. It ought also to be perfectly obvious truth for such able psychologists as these, that not all of the sense-perceptions or "ideas" are accompanied by this feeling of familiarity, facility or known-againness. Only a small fraction of the whole are so accompanied, yet on their argument it is quite necessary that they all should be so accompanied. This link in their chain-armor is decidedly weak, leads in fact to their utter undoing.

I fail also to see how the greater facility with which a presentation arises can *of itself* be the consciousness of known-againness. It is a valiant deed of Prof. Höffding's to attempt to solve this problem by calling this sense of facility the *Bekanntheitsqualität* and then asserting that it is something *ultimate*. The thing is easy, but the saying is hard to understand.

In the former article there were pointed out the mistake and confusion involved in the terms "new sensations" and "strange, unknown sensations." Ward (*Mind*, 1894, p. 353) makes a similar mistake: "Apart from all hypothesis or inference we have first a new or strange experience, A; then after more or fewer repetitions, we say this experience is 'cognized' or is '*familiar.*'" Upon the recognition-theory of perception, how is it that any object whatever, is for the *first* time cognized; for according to it, all cognition is recognition, and the recognition element is derived from the familiarity element, which is due to much repetition? These many words about change in an idea through practice and repetition are, to me at least, all beside the mark. *The change wrought is the greater facility of coördination in the centres necessarily involved in each presentation.* The slowness and delay of the coördinating activity of the nervous formations upon sight of something not seen before appear to be a much less hazardous hypothesis than that of the creation or gradual evolving of "new sensations." A part of the

gradually evolved feeling of familiarity with an object may be partly due to the play of associations, lacking in the first case and later gradually acquired; this association being again a further case of the coördinating activity of the various nervous formations. Perhaps the localization theory of brain functions may have some light for this psychological problem. Bonnet, according to the following (cited by Offner, *Philos. Monatsh.*, 1892, S. 407), propounded the same teaching as Höffding, Ward *et al.*: "*Ich habe daher gemuthmasst, dass jungfräuliche Fibern [auf die Seele nicht genau so wirken, wie diejenigen, welche es nicht sind; und ich habe die Empfindung der Neuigkeit eben diesem Zustande der Jungferschaft der empfindlichen Fibern zugeschrieben.*" "*Die Empfindung, die mit dieser mehreren Nachgiebigkeit und Beweglichkeit verknüpft ist, macht die Erinnerung (d. h. wohl nur jene eigenthümliche Färbung oder Qualität einer Vorstellung, welche sie als Erinnerung gegenüber der Wahrnehmung charakterisirt) aus, welche um so lebhafter wird, als die Fibern nachgebender oder beweglicher werden.*"

4. Recognition Objectively and Subjectively Considered.

"Recognition," "*Wiedererkennen*" and "*reconnaissance*," as at present used, are ambiguous terms. The objective and the subjective considerations of the process are not held apart. Hence arises an exemplification of the "psychologist's fallacy," *i. e.*, the confusion of the standpoint from which a conception or process is *expounded* with the standpoint at which it is *experienced.*[1]

Objectively considered, it means that a person may cognize an object a *second* time (*re*-cognition) without being subjectively aware that it is a second perception of the object. The second perception or presentation may be merely a simple awareness of the object, and yet be for the thousandth time perceived, and perceived with the greatest of facility. For the subject, however, it is at the time no proper recognition.

Subjectively considered, the true and proper recognition to be explained is the knowledge or consciousness that the object in question is again perceived or presented. It is known-againness.

According to Sully, Höffding, *et al.*, there is invariably in recognition "a recognizing of the former impression." This is certainly a false description of the facts. The affirmation of consciousness is *not* that the *former impression*, but that the *object, an external reality*, is again perceived, or is known again. The difference is all-important. Probably prepossessed

[1] Cf. Ward, *Journal of Spec. Philos.*, 1882, and James, "Principles."

and prejudiced by metaphysical assumptions of an "idealistic" character, the prevailing teaching has been that if there is a known-againness in recognition, then it cannot be of an external object, but of the former perception. If the former impression be therefore known again or recognized, it must necessarily be reproduced, and when recognition was extended to comprise the whole field of perception, the former impression must be there also, and if you cannot find it, it must be there, but unconscious! Ward, with more courage than his contemporaries or predecessors, goes still further, asserting in his doctrine of the *continuum* (Art. Psychology, Enc. Brit.) that all our presentations, both present and *past*, are still in consciousness, though most of them are there subconsciously! (And note, the word "subconscious" does not mean with Ward "unconscious.")

Consciousness in perception is object-awareness; in recognition it is object-known-againness, and not former-perceptions-known-againness. Höffding himself unwittingly admits it. "A single trait of a countenance, a color tone of the sky, an accidentally heard word can appear to us as known again (*bekannt*=recognized) *without our being able, or even without our feeling the need of referring them to definite former experiences* (*Erlebnisse*)" (*Psychologie*, 2te Aufl. 161).

Let us now take a case of recognition. I perceive now this book before me. That is a perception. If I had passed on to some other object immediately, there would have been no recognition of that book; but after the perception of the book, a fainter presentation of a person who gave me that book arose, although that person was not externally then present, and on the ground of that characteristic I classified that book as known-again.

I may close my eyes and have an idea-presentation of that same book. The presentation is to me an object, faint in its colors, incomplete in its details, localizable almost anywhere in space. If I do not notice those characteristics, other objects may succeed and there will be no known-againness; but if I notice those characteristics, I may then at once classify that object as being a *second* time known.

I have, when walking along the street, met a person who is a stranger to me; I say to myself, I have met him before, although I am otherwise certain that I never have. Upon closer examination, I found a pleasurable feeling which arose through the partial resemblance of that person's countenance with the countenance of one of my friends. I believe that the characteristic upon which the classification of known-againness was based was in this case the pleasurable feeling.

Often I have noticed the quick image-presentation which

frequently follows immediately after the sense-presentation, to be the characteristic which was the starting point for the classification.

Neither the characteristics nor the classification, taken alone, make up recognition, but both together. The characteristic may be variable, the classification remains the same.

5 Some Characteristics.

1. Lack of liveliness, freshness and vividness in contradistinction to the qualities of objects perceived or the objects of hallucination. (Hume.) This lack of freshness, etc., may possibly consist in lack of details, or in duller and less strong sensations.[1] I need scarcely add that not only the objects of central excitation, but also the objects of peripheral excitation are capable of being known-again or recognized.

The opposite characteristics, *i. e.*, liveliness, freshness, vividness, fixity of spatial localization, etc., are the characteristics upon which is based the classification of the object as known, *here* or *there*, and *now*. This is perception. Objects are often perceived with these characteristics and are accordingly classified as *perceptions* when they are really *hallucinations* or *sense-illusions*. *At the moment* they are for the subject perceptions, and at the moment the classification upon the basis of certain characteristics took its normal course. Later observation shows that the external object really was not present. I believe that I have experienced cases of the opposite kind, where the object of the peripherally excited presentation was given very faintly and the classification ensued of known-againness.

2. Absence of definite spatial localization. The image (centrally excited presentation) of a friend may be localized almost anywhere or anyhow; in the perception of that friend, the object is exceedingly definite in its localization. Upon this characteristic, a classification may follow.

3. The lack of persistency, air of freedom possessed by images in contradistinction to the obstinate steadfastness of perceptions. Through all preceding philosophical speculation, there has been an emphasis of this phenomenon. In perception, they said, the mind was more *passive*, the image of the outer object was *impressed* upon the mind, the mind was more or less determined; while in the idea-world, there was freedom, and free activity. Perception is and has been one

[1]For the discussion of this question we may refer to Lotze, "Metaphysik," 502-539; "Med.Psych.," 225. Stumpf, "Tonpsych.," Bd. I,373 ff.; Bd. II, 276 ff. James, "Principles," I, 425. A. Meinong, "Viertel. f. wiss. Philos." XIII, *Ueber Begriff und Eigenschaften der Empfindungen.*

of the anchors of certainty. "*Mein Jetzt und Hier ist der letzte Angelpunkt für alle Wirklichkeit, also alle Erkenntnisse*" (Lipps, *Grundtatsachen*, S. 400). "*Sonnenklar ist nur das Sinnliche, nur wo die Sinnlichkeit anfängt, hört aller Zweifel und Streit auf. Das Geheimniss des unmittelbaren Wissens ist die Sinnlichkeit*" (Feuerbach).

4. The absence of muscle, joint and other sensations. The presence of some of these in certain cases of perception and the presence of others in reflection, recollection, etc., is manifest.

5. The sudden introduction into consciousness of an object by association of ideas, which object does not in the case in question properly belong to the object perceived, or to its present surroundings. By this it is known that the object perceived is known again. According to common parlance, in certain cases we must have seen that thing before, because we know its former surroundings (N. B. Recollection of a forgotten word or name). This characteristic is one of very frequent occurrence. In the *Cornhill Mag.*, Vol. XLI, p. 427, Art. "Illusions of Memory," there is a reference to this: "How many have been disappointed in revisiting old scenes to find the old, expected charm lacking! Things are not as they were. For instance, a person recalls a hill near the home of his childhood, and has the conviction that it was of great height. On revisiting the place he finds that the eminence is quite insignificant. How can we account for this? For one thing, it is to be observed that to his undeveloped childish muscles the climbing to the top meant a considerable expenditure of energy, to be followed by a sense of fatigue. The man remembers these feelings, and unconsciously reasoning by present experience, that is to say, by the amount of walking which would now produce this sense of fatigue, imagines that the height was vastly greater than it really was. Everybody knows the tendency to exaggerate the impressions of early life, as youth is the period of novel effects, when all the world is fresh and vivid, and new and striking impressions crowd in thickly on the mind. Who has not felt an unpleasant disenchantment in revisiting some garden or park that seemed a wondrous paradise to his young eyes? Past ideals, rosy and fresh, when once more seen, take on a ghastly hue."

6. The great rapidity and often surprising ease and quickness of the act of perceiving, due to preceding practice, dreams, perception, etc. Often a second idea-presentation of the object arises immediately after the perception. This characteristic is certainly one of the chiefest in recognition, including of course those cases of strange familiarity cited at the beginning of this article.

Dreams, *preperception*, *former thought*, all leave behind, on the physiological side, dispositions to be excited again in the same manner, and when a part or parts of similar thoughts again arise, there follow at once the former associations. Hence one of the characteristics by which we judge that we have seen this thing before. This has a great practical importance for the provinces of literary, scientific and art criticism. A critic believes that the new book which has been laid upon his dissection table has been already read by him; another believes even to recognize the verses which he reads for the first time. Another knows beforehand the conclusion of a novel; another again finds a new philosophical system old in all its parts—a thing easily understandable. Who has not heard of Oskar Blumenthal's "Aehnlichkeitsjäger," who hear in every note of music agreements or coincidences with well-known compositions. Dreams have quite obviously a telling effect here.

Waking imagination is another source of these "illusory" recollections. In certain morbid conditions of mind, and in the case of the few healthy minds endowed with special imaginative force, the products of this mental activity closely resemble dreams in their vividness and apparent actuality. When this is the case, illusions of memory may arise at once just as in the case of dreams. This will happen more easily when the imagination has been for some time occupied with the same group of ideal scenes, persons, or events. To Dickens, as is well known, his fictitious characters were for the time realities, and after he had finished his story, their forms and their sayings lingered with him, assuming the aspect of personal recollections.

Wigan's case ("Duality of Mind," 85 ff.) is a good exemplification of the point in question. "The strongest example of this delusion I ever recollect in my own person was on the occasion of the funeral of the Princess Charlotte. The circumstances connected with that event formed in every respect a most extraordinary psychological curiosity, and afforded an instructive view of the moral feelings pervading a whole nation and showing themselves without restraint or disguise. There is, perhaps, no example in history of so intense and so universal a sympathy." After describing the universal sympathy and grief, its causes, and how it infected everybody, he proceeds as follows: "I had obtained permission to be present on the occasion of the funeral as one of the lord chamberlain's staff. *Several disturbed nights previous to that ceremony, and the almost total privation of rest on the night immediately preceding it, had put my mind into a state of hysterical irritability, which was still further increased by*

grief and by exhaustion for want of food, for between breakfast and the hour of interment at midnight, such was the confusion in the town of Windsor that no expenditure of money could procure refreshment.

"I had been standing four hours, and on taking my place by the side of the coffin, in St. George's chapel, was only prevented from fainting by the interest of the scene. All that our truncated ceremonies could bestow of pomp was there, and the exquisite music produced a sort of hallucination. Suddenly, after the pathetic "Miserere" of Mozart, the music ceased, and there was an absolute silence. The coffin, which was placed on a kind of altar covered with black cloth (united to the black cloth which covered the pavement), *sank down so slowly through the floor that it was only in measuring its progress by some brilliant object beyond it that any motion could be perceived. I had fallen into a sort of torpid reverie*, when I was recalled to consciousness by a paroxysm of violent grief on the part of the bereaved husband as his eye suddenly caught the coffin sinking into its black grave formed by the inverted covering of the altar. In an instant I felt not merely an *impression*, but a *conviction*, that I had seen the whole scene before on some former occasion, and had heard even the very words addressed to myself by Sir George Naylor."

I have italicized certain lines of this well-delineated case, lines which indicate, along with other points brought out in this essay, the explanation of the phenomena in question.

Lalande ("Sur les paramnesies," *Rev. Philos.*, XXXVI, 485-497) rightly remarks that the paramnesia can possiby be produced by the very peculiar and almost indefinable acceleration of speed which the perception at the moment takes on. Before reading this and since, I have endeavored to study carefully every instance in my own experience of this feeling of strange familiarity often displayed in recognition, and I find in the majority of cases this peculiar acceleration as the chief characteristic, together with a rapid second idea-presentation of the object perceived. Persons in a low, nervous state of health, and others afflicted with epileptic tendencies, are often subject to this feeling, because of the unforeseen, unlooked-for rapidity of the nervous impulses underlying many of their perceptions. Arbitrary, involuntary, impulsive nerve movements are thus the primary causes of these phenomena. The patient acts as usual in classifying the phenomena as familiar and known-again; the mechanism is, however, acting unusually.

Vivid dreams leave their strong after-effect upon our waking thoughts. How hard it is sometimes to shake off the impression left by a vivid dream that a dead friend has

returned to life! During the day that follows the dream, we have at intermittent moments something like an assurance that we have surely seen the departed one; and though the impression is immediately corrected by reflection, it tends to revive within us with a strange pertinacity. It is highly probable that our dreams are thus, to a large extent, answerable for the sense of familiarity that we sometimes experience in visiting a new locality, or in seeing a new face.

Although we are not here concerned with time calculations, it may be well to quote the following from Oliver Wendell Holmes in his essay, "Bread and the Newspaper": "When any startling piece of war news comes, it keeps repeating itself in our minds in spite of all we can do. The same trains of thought go tramping round in circle through the brain, like the supernumeraries that make up the grand army of a stage show. Now, if a thought goes round through the brain a thousand times in a day, it will have worn as deep a track as one which has passed through it once a week for twenty years. This accounts for the ages we seem to have lived since the twelfth of April last, and, to state it more generally, for that *ex post facto* operation of a great calamity, or any very powerful impression, which we once illustrated by the image of a stain spreading backwards from the leaf of life open before us through all those which we have already turned."

7. Frequently, after an object has been quickly perceived, there arises a feeling of *hindrance*, where some expected associated presentations do not arrive. Hughlings-Jackson ("On Intellectual Aura," *Brain*, 1889, 179 ff.) says in this connection, "I have been struck by certain non-associations." And James ("Principles," I, 252 and 673 ff.) writes: "There are cases where too many paths, leading to too diverse associates, block each other's way, and all that the mind gets along with its object is a fringe of felt familiarity or sense that there *are* associates. A similar result comes about when a definite setting is only nascently aroused. We then feel that we have seen the object already, but when or where we cannot say, though we may seem to ourselves to be on the brink of saying it. That nascent cerebral excitations can affect consciousness with a sort of sense of the imminence of that which stronger excitations would make us definitely feel, is obvious from what happens when we seek to remember a name. It tingles, it trembles on the verge, but does not come. Just such a tingling and trembling of unrecovered associates are the penumbra of recognition that may surround any experience and make it seem familiar, though we know not why."

8. Often a feeling of pleasure upon perception of an object, the cause of the pleasure being hardly known.

These characteristics are not supposed to be completely enumerated, nor given in the order of their importance. In themselves they are not recognition. Moreover, an object may be perceived and anyone of these characters may possibly accompany that perception, but that will not constitute a recognition. There must be a classification as known-again.

6. The Classification.

At some early period in life there arose the distinction between perceptions and centrally excited presentations, or what are generally called ideas. If the child's environment had always been the objects *a*, *b*, *c*, *d* and *e*, there would have arisen invariably the concomitant perceptions *a*, *b*, *c*, *d* and *e*; but the case not being so, the time comes when the child's brain becomes so formed that upon perception of *a*, *b*, there may be absence of the external realities *c*, *d* and *e*, the child, however, because of its already formed association-paths, having the images or ideas of *c*, *d* and *e*. Gradually it learns to know that when it has certain characteristically formed presentations, faint, dim, etc., there are no corresponding external realities. There arises a classification of presentations. The ideas, like the perceptual presentations, are simply object-knowledge; when their characteristics are noticed and the presentations classified, there arises a distinction. Some fresh, full, vivid, steady in their spatial localization, etc., are called *objects present;* others, with the opposite characteristics, are called *objects known-again.* This, as far as I can see, is a simple classification, like that of certain sensations, into color sensations and sound sensations.

I emphasize the point again: it is not a classification of *perceptions present* and *perceptions known-again;* it is *objects present* and *objects known-again.* This confusion has caused volumes of error and misconception. Perceptions, when they once pass out of consciousness, are never known again, for they no longer exist. Recognition has appeared a very mysterious thing because of this fundamental error.

Prof. James ("Principles," I, 648) writes: "Memory proper, or secondary memory as it might be styled, is the knowledge of a former state of mind, after it has already once dropped from consciousness; or rather, *it is the knowledge of an event or fact* of which, meantime, we have not been thinking, *with the additional consciousness that we have thought or experienced it before.*" As the facts appear to me, there is no alternative here at all. The first part of the statement is

absolutely incorrect. An act of memory is not correctly described by saying that it is knowledge of a former state of mind. The former state of mind is irremediably gone forever, and *it* we can never know again. The *object*, however, of which it was a knowledge can be known again, and that is the testimony of consciousness. James quotes Ladd as saying ("Physiol. Psych.," Pt. II, chap. x) : "It is a fact of consciousness on which all possibility of connected experience and of recorded and cumulative human knowledge is dependent that certain phases or products of consciousness appear with a claim *to stand for* (*to represent*) past experiences to which they are regarded as in some respect similar. It is this peculiar claim in consciousness which constitutes the essence of an act of memory," and asks why, instead of the italicized words "to stand for (to represent)," Ladd should not use the word "know," thus implying that one can know our past experiences. James' final dictum is that "the past is known," and that "the straightest and shortest way of saying it is the best" (p. 689)— certainly a suicidal policy if it denies the facts.

Ladd speaks of "that peculiar and mysterious *actus* of the mind, *connecting* its present and its past, which constitutes the essence of memory." A Gordian knot, truly, if the facts were such as they are represented to be. The *past* feelings and experiences no longer exist, and they are hence no longer "*connected*" by "that peculiar and mysterious *actus* of the mind," nor does consciousness assert that the past experiences are known or are connected with the present experiences. Centrally excited presentations of objects once perceived may arise, but they are *not* the past experiences or knowledge of past experiences. They are a re-knowing of the same object. For the person concerned, they become memories by a classification based upon certain characteristics.

What is meant, it may be asked, by the oft-repeated phrase, "referring a fact to the past"? I have a remembrance now of sitting at the window yesterday and looking at a funeral passing slowly down the street. In this act of memory I do not "know the past," as affirmed by Ladd, James, *et al.;* there are, on the contrary, visual presentations of myself sitting at the window, the street and the long line of passing carriages. Similar presentations to those of yesterday pass through my mind. There then follow knowledge of certain characteristics and the classification. The "referring a fact to the past" would then mean the thinking or presentation of that object, fact, or event *with* the objects and events associated with it and the classification as known-again.

Furthermore, the introduction of associated objects, as described in the fifth characteristic, does not of itself constitute memory, nor is it always an integral part of memory. Christian Wolf (*Psychologia Empirica*, S. 174, quoted by James) writes: "Suppose you have seen Mevius in the temple, but now afresh in Titus' house. I say you *recognize* Mevius, that is, are conscious of having seen him before, because, although now you perceive him with your senses along with Titus' house, your imagination produces an image of him along with one of the temple, and of the acts of your own mind reflecting on Mevius in the temple. Hence the idea of Mevius which is reproduced in sense is contained in another series of perceptions than that which formerly contained it, and this difference is the reason why we are conscious of having had it before. . . . . For whilst now you see Mevins in the house of Titus, your imagination places him in the temple, and renders you conscious of the state of mind which you found in yourself when you beheld him there. By this you know that you have seen him before, that is, you recognize him. But you recognize him because his idea is now contained in another series of perceptions from that in which you first saw him." This describes rather well one of the grounds or characteristics upon which the classification is based, but it is not of itself recognition. James writes (p. 657): "It is the *setting* of the idea, when it recurs, which makes us conscious of it as past." The following statement is, however, not wholly correct: "The only hypothesis, in short, to which the facts of inward experience give countenance is that *the brain-tracts excited by the event proper, and those excited in its recall, are in part different from each other*. If we could revive the past event without any associates, we should exclude the possibility of memory, and simply dream that we were undergoing the experience as if for the first time."

The added or differing associates in themselves are no memory. They are like the object proper, simply further object-consciousness. They may, however, act as one of the *characterization-causes* of the ensuing classification.

Furthermore, it may be added that there is in recognition no "identification of the past impression with the present one." We do not perceive the "sameness, similarity and identity" of the two. Recognition can take place without a second presentation of the same object, as has been shown above, where the characteristic upon which the classification is based may be in certain cases only the acceleration of the perception, or the faintness of the idea-presentation, or an accompanying pleasure-feeling. There would be in these

cases of recognition no comparison of present impression with past ones at all. If this be so, then the latter part of Stumpf's statement is not true. "*Die vielen neueren Untersuchungen über das 'Wiedererkennen' beachten nicht eine Mehrdeutigkeit des Ausdruckes. Zuweilen bedeutet es nur 'wiederholtes Erkennen' und dann involvirt der Akt keine Vergleichung. In anderen Fällen bedeutet er 'Erkenntniss der Gleichheit oder gar der realen Identität eines Gegenwärtigen mit einem Vergangenen' und dann involvirt er natürlich eine Vergleichung*" ("Tonpsychologie," Bd. II, S. 7).

Moreover, we can never be absolutely sure that our classification of an object as *known-again* is absolutely correct. The characteristic may attach itself to certain presentations to which it normally or usually does not belong. Hence arise our *illusions of recognition*. The robber disappears into the darkness of the night, leaving some footprints behind him; bring the robber back, compare the prints with the robber's boots, and we may have a moral certainty that we have the same robber. In the case of recognition we can never bring back the former impression.

Thus we return to our starting point, the strange sense of familiarity and the phenomena of paramnesia. These phenomena of familiarity and paramnesia are certainly cases of the general process of recognition, and are to be explained in the same manner. They are parts of a general whole. The names given to these phenomena are many, as, for instance, "double memory," "dreamy states," "preternatural presentiments," "mental mirages or *Empfindungsspiegelung*," "reminiscence," "pseudo-reminiscences," and the "indescribable been-here-before feeling" of daily life.[1] They occur in both our normal and abnormal life, although they probably occur more frequently as pathological cases. It is certainly not uncommon among the epileptic,[2] and cases are reported in other forms of insanity. It is also very often connected with a fatigued and wearied state of the bodily system. Dreams, whether the "half-dream conditions" described above, or day-dreams, or reveries, or the dreams of sleep, give rise very often to one or more or similar characteristics (as described above) upon which the classification is founded. Preperceptional mental activity and that kind of mental presentation often called "unconscious" because unaccompanied by attention, give rise to one or more of the characteristics. Thus in the case of Wigan, cited above,

[1] For literature and cases, see Prof. W. H. Burnham in this JOURNAL, Vol. II, pp. 439-464.

[2] See Hughlings-Jackson, "Intellectual Aura," *Brain*, July, 1888; Neumann, "Lehrbuch der Psychiatrie," S. 112, and others.

and which deserves careful study, there were plainly several of these factors at work. In our general normal life, our dreams may have been very vivid, but, perhaps, in our daily life forgotten, crowded out by the stress and strain of other things. In a moment of fatigue or weariness, when the bodily tension and normal coördinated strain are loosened, the nervous impulses may be more jerky and, so to speak, more unaccountable. There then arises suddenly, by the machinery of the association of ideas, a vivid and belief-compelling idea-presentation or a warm feeling of pleasure, which really has no connection with the perceived object *A*, which is not given by the context of surrounding objects. Upon this characteristic there immediately arises the classification of known-againness. These unforeseen, unlooked-for associates are apt especially to come to the front in the approach to and in great nervous disorganization, as in cases of fatigue, weariness, epilepsy, *dementia paralytica*,[1] etc. Hence it is that it is sometimes a characteristic for the physician's prognosis and diagnosis of these diseases. Apropos of this I may cite from Burnham (*loc. cit.*, pp. 442-4): "Kraepelin cites two cases of epilepsy where the patient had this form of paramnesia. Hughlings-Jackson has reported several cases where, in the 'intellectual aura' or 'dreamy state,' false memories occurred. One of the most important of his cases is that of a highly educated physician who is subject to attacks of *petit mal* and *haut mal*. In his report of his own case this gentleman mentions illusions of memory in the initial stages, both of *petits maux* and *hauts maux*. Speaking of his mental condition in the former, he says: 'In a large majority of cases the central feature has been mental and has been a feeling of recollection, *i. e.*, of realizing that what is occupying the attention is what has occupied it before, and indeed has been familiar, but has been for a time forgotten, and now is recovered with a slight sense of satisfaction, as if it had been sought for. My normal memory is bad, and a similar but much fainter feeling of sudden recollection of a forgotten fact is familiar. But in the abnormal states, the recollection is much more instantaneous, much more absorbing, more vivid, and, for the moment, more satisfactory, as filling up a void, which I imagine at the time I had previously in vain sought to fill. At the same time, or, perhaps I should say more accurately, in immediate sequence, I am dimly aware that the recollection is fictitious, and my state abnormal.'

"In another case reported by Ferrier, a woman had attacks

[1] Kraepelin found simple paramnesia a very characteristic accompaniment of *dementia paralytica*. *Archiv f. Psych.*, Bd. XVII and XVIII, *Ueber Erinnerungsfälschungen*.

of *le petit mal* that were divided into three distinct stages, of which 'the first stage is a dreamy state or reminiscence, in which everything around her seems familiar or to have happened before.'

"Several years ago, another physician, subject to attacks of epilepsy, suggested that this form of paramnesia might serve as prognostic of epilepsy. In his own case he came to treat the experience 'as an indication for immediate rest and treatment.' Apropos of this case Hughlings-Jackson says: 'I should never, in spite of Quaeren's case, diagnose epilepsy from the paroxysmal occurrence of 'reminiscence' without other symptoms, although I should suspect epilepsy if that super-positive mental state began to occur very frequently, and should treat the patient according to these suspicions were I consulted for it.' He emphasizes, however, the advantage of noting this phenomenon as a possible symptom of epilepsy."

Probably the larger part of the cases of paramnesia reported have been epileptics. Jensen reports the case of a patient complaining to him, "Doctor, I feel so very strange to-day. When I stand now like this and look at you, then it seems to me as if you had stood there once before, and as if everything had been just the same, and as if I knew what was coming; and when I think about it, I get so frightened (*schucherich*, a word used by the patient to designate the attacks), and I go back and turn around; and when it is over, the whole thing seems so ridiculous—and it has been so all the time to-day—I don't know what ails me." On finishing these words the patient immediately had an attack.[1]

In normal life this recognition-illusion is immediately corrected. The association paths are traversed by nervous impulses in the customary way. In the abnormal state of weariness, epilepsy, etc., the impulses are unusually rapid and freaky, if I may use the word. There is a nervous jerkiness which produces unwonted, unlooked-for associates. Hence arise those characteristics mentioned above in unusual or abnormal association with the perceived objects. It depends upon the condition of the patient's nervous system whether and how soon the illusion will be corrected. In dreams, which may be designated pathological associational mental life, the illusion is seldom corrected, the normal associations of the wide-awake life fail to put in an appearance, thus leaving the nervous impulses to a sort of arbitrary play. In cases of acute paramnesia, it is impossible often to cure the patients of their delusions.

[1] *Vide* Burnham, *loc. cit.*, p. 459.

The ease and quickness of these cases of recognition have been a prominent feature in my experiences. The rapidity with which an object has been perceived, and the surprising immediacy and celerity with which the same object, or some apparent associate, arises at once after the perception of the object, have been to me, at least, the chief and most frequently occurring characteristics upon which the classification has been based. I speak now especially of the abnormal cases of recognition, *i. e.*, those of paramnesia. This again finds its easiest explanation in unusual excitability, irritability and jerkiness of movement in the central nervous impulses, involved in the machinery of the association of ideas. Prof. Burnham (*loc. cit.*, p. 447 in a note) writes that "a fellow-student of psychology . . . has often observed this form of illusion in his own dreams, and thinks they generally occur in morning dreams. The over-rested condition of the nerve centres may, he thinks, explain this phenomenon. When we see a strange object, its unfamiliar aspect is largely due to the difficulty we find in apperceiving its characteristics. The process of becoming acquainted with a thing consists in making the act of apperception easy. Hence, when the brain centres are over-rested, the apperception of a strange scene may be so easy that the aspect of the scene will be familiar. The fact observed by Anjel that this illusion is apt to occur in conditions of fatigue, does not necessarily conflict with this explanation. In the cases observed there may have been an abnormal ease of apperception due to hyperæsthesia induced by the fatigue. It may be added that Bonatelli thinks that illusions of memory occur in states of unusual nervous irritability. Such, in his opinion, would be the condition in vivid dreams, and in the unusual circumstances of journeys and the like."

PSYCHOLOGICAL LITERATURE.

I.—NEUROLOGICAL.

Experimental Degenerations Following Unilateral Lesions of the Cortex Cerebri in the Bonnet Monkey (Macacus Sinicus). E. LINDON MELLUS, M. D. Proc. Royal Soc., LVIII, pp. 206-14. 1895.

Physiologically, by direct stimulation of the cortex, it is impossible to do more than follow out a few of the main lines of relation between the cortex and the muscular system. By cutting away the cortex and applying the stimulus to the fibres of the corona radiate of internal capsule or to the columns of the medulla or spinal cord, this method has also succeeded in tracing, after a fashion, the paths of motor fibres through different levels of the central axis. At best, however, results of this method lack precision. The anatomical method, depending on degenerations following a lesion, especially as now developed by Marchi, has made it possible to follow the course of nerve fibres with great accuracy. The present research has for its object to trace by Marchi's method all the fibres which arise in a small region of the cortex to their destinations in the cerebrum, medulla and spinal cord.

Fourteen successful operations are recorded, of which three are lesions of the hallux centre, four of the thumb centre and seven of four different centres in the facial area. These centres were first located by stimulation, and then a portion of the cortex, about 16 sq. mm., was cut out to its full depth. Each class of experiments is treated by itself in detail with the comparison of the results of each experiment in the class. For these details the reader is referred to the original paper. The more striking general results of the entire series of experiments may be summarized as follows.

From the lesion as a centre, degenerated fibres spray out in all directions to associated regions of the same hemisphere. These decrease quite uniformly in number with the distance from the lesion and do not cover so large a region as might be expected from current ideas regarding association fibres. For the above lesions they are confined to the central convolutions. In harmony with the observation of Bevan Lewis, that the cells of the fourth layer are large in the upper portions of the motor areas and small in those farther down toward the base of the brain, Mellus finds that the fibres that pass down are fine, while those that pass upward from the lesion are coarser. According to the individual lesion, either fine fibres or both fine and coarse fibres pass through the corpus callosum, or posterior commissure, to distribute themselves over an area in the other hemisphere very similar in outline to the area of degenerated fibres on the side of the lesion. To give the course of the degenerated fibres in the internal capsule, which is of

especial importance, I will quote from the author's summary. He says: "All the degenerated pyramidal fibres from the hallux and thumb lesions were found to enter the capsule at or near the posterior extremity, while the corresponding fibres from the facial lesions entered the capsule at or near the anterior extremity, and the former were displaced forward and the latter backward until in the lower levels of the capsule they all found a place in the middle third of the posterior limb. It is also shown that a line can be drawn from the fissure of Sylvius upward, so dividing the motor area into two parts that all the facial lesions from which fibres enter the anterior portion of the capsule would be in the anterior division, and all the hallux and thumb lesions from which fibres enter the posterior portion of the capsule would be in the posterior division. In the movement of the facial fibres backwards between the upper and lower levels of the capsule, they would necessarily, at some level, envelope the genu, which would account for the fact that they have always been described as occupying that position. These results correspond closely with those obtained by Beevor and Horseley by direct stimulation of the internal capsule in the same animal. As to the further course of the degenerated fibres, a large part of the fine fibres can be traced into the outer surface of the optic thalamus, and farther down, coarse fibres, which resemble in size and position true pyramidal fibres, pass as far as can be determined into the *substantia nigra*. These fibres going to the *substantia nigra*, moreover, about equal in number those passing down in the pyramids. In three of the facial lesions and in one thumb lesion, no other degeneration can be traced in the internal capsule than the stream of chiefly fine fibres to the thalamus and that of coarse fibers to the *substantia nigra*, no connection being demonstrable between the cortex and the facial nuclei or the motor nuclei in the cord. In all the other experiments, however, these relations are manifest.

A result of immense importance to the subject of bilateral control of the spinal cord by each cerebral hemisphere is clearly demonstrated for the first time in the monkey, though formerly shown to exist in the dog by Muratoff. Sherrington had noticed degenerated fibres in both crossed pyramidal tracts, and advanced the rather clumsy theory that after decussating in the medulla, these fibres recrossed at lower levels of the cord. The fact is that a considerable number of these fibres may remain upon the side of their cerebral origin not only in the anterior, but in the lateral pyramidal tract. Whether these finally cross at their terminations in the cord, as do the fibres of the anterior pyramidal tract, is not stated.

Another peculiar result found in three of the facial lesions is degeneration in the internal capsule of the side opposite to the lesion. All the lesions were made in the left hemisphere, and in these three cases the degeneration in the right capsule varied from one half to fully as much as occurred in the left capsule. The only way this could be accounted for on modern theories of degeneration would seem to be that these fibres crossed in the corpus callosum and passed down in the opposite capsule. As this cannot be shown to occur in the specimens, the fact must be left for the present unexplained.

By the courtesy of Dr. Mellus, the writer has seen the specimens and photographs from them and can testify that the above points are demonstrated in the most precise manner possible. There is every reason to hope that further work along this line which Dr. Mellus is undertaking will continue to yield most important results.

C. F. H.

Experimental Researches into the Function of the Cerebellum. J. S. RISIEN RUSSELL. Phil. Trans. Roy. Soc., 1894, II, pp. 819-61, 11 Figs. in text.

Degenerations Consequent on Experimental Lesions of the Cerebellum. J. S. RISIEN RUSSELL and A. W. CAMPBELL. *Brit. Med. J.*, Lond., 1894, II, 640-42; also, Proc. Roy. Soc., LVI, 303-5. 1895.

A Clinical Study of a Cyst of the Cerebellum; Weakness of Spinal Muscles; Death from Failure of Respiration. J. S. RISIEN RUSSELL with J. HUGHLINGS JACKSON. *Brit. Med. Journal*, Lond., 1894, I, pp. 393-5.

The Value of Experimental Evidence in the Diagnosis of Diseases of the Cerebellum. J. S. RISIEN RUSSELL. *Brit. Med. J.*, Lond., 1895, I, pp. 1079-82.

Defective Development of the Central Nervous System in a Cat. J. S. RISIEN RUSSELL. *Brain*, 1895, Lond., pp. 37-53, 10 Figs.

The cerebellum has been studied since Saucerotte with ever confusing and indefinite results. And it is only within the last two years that sufficient light as to its varied functions has been gained to place lesions of the cerebellum within the field of practical operative surgery. Much of the final work to this end has been accomplished by Dr. Russell, and is outlined in the above papers.

We are first treated to a brief review of the literature, including the recent work of Luciani, and from this is clearly seen the necessity of focussing experiment on the following seven points: 1, "Whether each lateral half of the cerebellum is capable of acting independently, or whether it is necessary for the connections between the two halves to be intact, in order that the functions of the organ should be properly performed." 2. "If impulses pass from one side of the organ to the other before they are transmitted to the cerebrum or spinal cord." 3. "What is the nature of the impairment of movement which results when portions of the organ are removed?" 4. "What relationship exists between one-half of the cerebellum and the cerebral hemisphere of the opposite side, and what is its probable nature?" 5. "Whether one lateral half of the cerebellum is related mainly to one side of the spinal cord, to the opposite side, or to both, and what the nature of the relationship is." 6. "What symptoms resulting from experimental lesions of the cerebellum are mostly to be relied on for localization?" 7. "Whether any, and if so, which, of the symptoms are dependent on interference with the labyrinth or eighth nerve when experimental lesions of the cerebellum are produced." The research is thus seven-fold, including all the difficult and disputed points of cerebellar physiology, and for each point a special line of experiments was planned. Most of the experiments were made upon dogs, results of these, however, being compared with those obtained from monkeys, and the case of a cat with defect in development of cerebellum sufficing to show very similar relations in this species.

Median section of the cerebellum, the line of experiment employed to prove whether the cerebellum acted as a unit or as a bilateral organ, caused remarkably little disturbance. This is taken to indicate, in contradiction to Luciani's reiterated dictum, "that the cerebellum is a unit; that one-half of the cerebellum does not, in any great measure, depend on the coöperation of the other half for the proper performance of its functions. The bulk of the impulses pass from one-half of the organ to the cerebrum, or to the

spinal cord, without passing to the other half." Thus this refractory part falls into line with all the other parts of the nervous axis as a bilateral organ, and a foothold is gained for the experiments to follow.

The most important results touching the relations of the cerebellum to the cerebrum on the one side and to the spinal cord on the other, are thus naturally given by ablation of one lateral half of the organ. A striking result of this operation is shown in the increased excitability of the opposite cerebral hemisphere. Tested with the faradic current, with cerebellum intact, both hemispheres are equally excitable. After ablation of one-half of the cerebellum the opposite hemisphere becomes much more excitable, and continues so for at least three months after the operation. This is also clearly demonstrated by the administration of absinthe, the contractions occurring during the epileptic seizures being enormously greater on the side of the ablation, while it was also clear that the convulsions on the other side were diminished. Furthermore, the character of the convulsions on the two sides tends to become different, in intact animals the characteristic tonic contractions tending strongly to become clonic upon the operated side. The tracings taken from several experiments and reproduced in the first paper noted show these differences in a striking manner.

Impairment of movement occurs after unilateral ablation. This Luciani explains as due to his three factors, astasia, asthenia and atonia. Russell also distinguishes three factors, which he names incoördination, rigidity and motor paresis. The two former conditions would seem to be due chiefly to the increased excitability of the opposite cerebral hemispheres; the paresis, as the author states, is "probably directly due to the withdrawal of the cerebellar influence from the muscles." The chief result of this line of experiments is that "the one-half of the cerebellum controls the cells of the cortex of the opposite cerebral hemisphere, and those of the anterior horns of the spinal cord on the same side chiefly, and on the opposite side to a slight extent." Thus, while the cerebrum has chiefly a crossed relation to the body, the relation of the cerebellum is mainly direct.

The symptoms characteristic of unilateral ablation of the cerebellum are summarized as follows: 1. Rotation and reeling to the opposite side. This is a prime symptom, and is the exact opposite of the results of most other observers, who state that the reeling is toward the side of the lesion. Further, when describing the phenomenon in an affected person, Dr. Russell clearly indicates that "the turning is toward what I should call the side of the lesion." For right unilateral ablation the rotation is that of a "cork-screw going into a cork;" for left ablation, that of a "cork-screw coming out of a cork," that is, to the right for right lesion and to the left for left lesion. Attention has been called to this apparent discrepancy, and Dr. Russell has rejoined that he intends clearing up the matter in a special paper.

Among the other symptoms, the face on the affected side is turned upward and the spinal column is convexed on the side of lesion; and there is incoördination, rigidity, especially of the fore limb, exaggeration of tendon reflexes, motor paresis, anæsthesia and analgesia, the three latter also affecting the posterior extremity of the opposite side. The opposite eyeball deviates downwards and outwards, while that of the same side, if abnormal, turns upwards and to the affected side. Nystagmus also occurs, in which the jerks are toward the side of lesion.

The general result of the whole research is that instead of considering the cerebellum as a distinct organ and trying to prove

a distinct function for it, we should treat it as a part of the great central axis, which coöperates with many other parts in the performance of many different functions, the chief difference between one part of this great system and another being the degree in which different functions are represented in any given part: *e. g.*, with regard to motor power, the anterior extremity is maximally represented in the cerebrum and minimally in the cerebellum, whereas the trunk muscles are minimally represented in the cerebrum and maximally in the cerebellum. The disturbances of eye movements, which Luciani considered "irritative," Russell would make paralytic. Experiments in various ways on the auditory nerve and labyrinth prove that disturbances in this region are different from those arising from cerebellar lesion.

The whole clinical bearing of his investigations, together with references to a number of clinical cases, is discussed in the papers referred to in the *British Medical Journal*.

Degenerations following removal of various parts of the cerebellum, especially those occurring after unilateral ablation, are of especial interest as confirming or failing to confirm the results of Marchi, Ferrier and Turner. "Removal of one lateral lobe of the cerebellum results in degeneration of all the peduncles on the side of the lesion, and in the superior peduncle of the opposite side. The degenerated fibres in the superior peduncle on the side of the lesion decussate in the posterior quadrigeminal region, and pass to the opposite red nucleus and optic thalamus. None could be traced beyond this point." The degenerated fibres in the opposite superior peduncle came from the region of the cut, and occurred in both superior peduncles after median section. This is taken to controvert Marchi's statement that none of the peduncles contain commissural fibres. The degenerated fibres of the middle peduncle pass to the gray matter of the opposite side of the pons. Marchi's result that fibres from this peduncle pass in the fillet and posterior longitudinal bundle to the corpora quadrigemina, in the pyramids to the corpora striata, or to the roots of the cranial nerves, is not confirmed. Fibres degenerating in the inferior peduncle occupy the lateral region of the medulla, thinning out rapidly as they pass down. A few scattering fibres can be traced in the antero-lateral region of the cervical cord, where all signs of degeneration cease. Degenerated fibres pass in this peduncle to both inferior olives. Russell confirms Marchi, contrary to the results of Ferrier and Turner, in demonstrating degenerated fibres in all the peduncles after excision of the middle lobe. Ferrier and Turner, on the other hand, are confirmed against Marchi in not finding any antero-lateral tract degenerated throughout the length of the cord, where only the cerebellum is injured.

In this connection it is of interest to note that Campbell's findings in several human cases (*Brit. Med. Jour.*, part of Russell's paper) gives the startling result of degeneration downward in the direct cerebellar tract in unilateral lesion of the cerebellum. In the cat, too, with defective development of the right lobe of the cerebellum, deficiency also occurs in the corresponding direct cerebellar tract. Attention was called to this animal by its resemblance to Dr. Russell's dogs with unilateral ablation of the cerebellum. The post mortem examination fully confirmed Russell's diagnosis, the right lobe of the cerebellum being scarcely one-third the size of the left. This case furnishes, among others, one other point of especial interest. Whereas the right cerebral hemisphere is but slightly smaller than the left, the right crus is very small and completely disappears in the upper levels of the pons, so that no trace

of a right pyramid is observable in the medulla. At the usual level the left pyramid divides, as in some of Mellus's cases, the greater part passing to the right side, about a fifth remaining on the left side. The striking point, however, is that the cord below the decussation very soon comes to present perfectly normal pyramidal tracts. It is difficult to explain how this can happen on any other assumption than that some, and it would seem the larger part, of the pyramidal fibres really arise in the cord, and not in the cortex, as is usually taught.

We are certainly indebted to Dr. Russell for a vigorous stirring of these already troubled waters, and there appears to be good reason to hope that they will clear into a much better anatomy and physiology of this difficult region than we have had heretofore.

C. F. H.

An Experimental Investigation of Eye Movements. J. S. RISIEN RUSSELL. *Journal of Physiology*, XVII, Nos. 2 and 3, pp. 1 to 27, 3 Figs. in text.

A serious difficulty in the localization of eye movements in the cerebral cortex has been the fact that only lateral movements have been obtained from cortical stimulation. Hughlings Jackson recently made the suggestion that the absence of other movements might be accounted for by the *degree* of representation of the various movements in the same general centre, the lateral movements of the eyes being predominantly represented over the area for control of the eyes. If this supposition be correct, by excluding these movements, cutting the lateral recti, it ought to be possible to obtain other movements on stimulating the motor eye centres. An experimental test of this suggestion in the hands of Dr. Russell proved Jackson's view to be correct, and this result cannot fail to exert a widespread influence upon general theories of cerebral localization. Beyond this point Dr. Russell discusses the relative control of the eyes by the cerebellum and cerebrum.

By cutting the external rectus of one side and internal rectus of the other, and stimulating the cortex of the side with the intact recti, the possibility of lateral movements was excluded and practically all the other movements of the eyes were obtained, viz., direct downward and upward rotations, rotations downward and to the opposite side and upward and to the opposite side, and occasionally also convergence, were obtained, each corresponding to a more or less clearly defined cortical area.

Ocular deviations artificially produced in dogs by ablation of the whole or part of the cortical area for eye movements on one side are recovered from in time, but reappear in narcosis, to be lost again in the total paralysis of the eye muscles normally occurring in the deeper states. Explanations founded on hypertrophy of residual cells, cerebellar compensation and compensation by the other hemisphere are suggested, but none is supported to the exclusion of the others. Careful control experiments on normal dogs were conducted to exclude false results.

Extirpation of one lateral half or part of one lateral half of the cerebellum produces downward and variable outward rotation on the opposite side. Total excision produces a downward and slightly outward rotation of both eyes. All experimentally induced rotations ultimately disappear, but may be caused to reappear in narcosis. Nystagmus is generally also present with slow jerking movements immediately after lesions, or, in cases of total extirpation, accompanying, and in the same direction as, voluntary move-

ments. This latter paralytic form, like the deviations themselves, gradually disappears, to reappear only in the first stages of narcosis. Control experiments on the labyrinth and eighth nerve do not overthrow the conclusions regarding the cerebellar influence upon eye movements.

Experiments consisting of ablations of cortical and cerebellar areas simultaneously and in sequence seem to show that one lateral half of the cerebellum and the opposite cortical centre exert a combined influence tending to move the eye in one direction, while the other lateral lobe and the other hemisphere give movements in the opposite direction. These two influences are antagonistic: take away the whole of one and the other predominates; take away half of each and the remaining halves antagonize each other. The cerebellum seems further to exercise a direct action on the ocular muscles perfectly independent of cortical mediation.

C. C. STEWART.

Obere Schleife und Hirnrinde. DR. MAX BIELSCHOWSKY. Neurolog. Centralblatt, Vol. XIV, p. 205.

Ein Beitrag zur Lehre vom Schleifenverlauf (obere, Rinden, Thalamusschleife). Von. DR. CHRISTFRIED JAKOB. Neurolog. Centralbl., Vol. XIV, p. 308.

Sur les connexions du ruban de Reil avec la corticalité cérébrale. M. et Mme. J. DEJERINE. Extrait des comptes rendus des séances de la Société de Biologie. Séance du 6 Avril, 1895.

The discussion on the central termination of the sensory pathways seems to come nearer a conclusion. There were practically two views represented: Flechsig and Hösel maintain that fibres which come from cells of the nuclei of Goll and Burdach and form the interolivary stratum and the fillet, terminate in the parietal region of the cerebral cortex. Von Monakow and Mahaim, on the other hand, state that there is no direct connection between the fillet and the cortex, but that the connection is indirect, by means of the optic thalamus.

Bielschowsky examined two dogs' brains, in which Professor Goltz had removed one hemisphere with the corpus striatum in one case and both hemispheres with the corpora striata in the other. The first dog lived two years and five months after the operation, the second nine months after removal of one and two months after removal of the other hemisphere. In both dogs, the optic thalamus was not injured, but showed secondary atrophy (just as in Von Monakow's experiments); the fillet, however, was neither atrophic nor degenerated; hence the conclusion that the fillet is merely a connection between the nuclei of Goll and Burdach and the optic thalamus, and that a second nerve cell is needed for the connection between the optic thalamus and the cortex.

The greatest and most valuable material has been published by M. and Mme. Dejerine. They have no less than nine cases in which the fillet was involved, and nineteen cases in which the fillet might have been involved, if Flechsig and Hösel's views were correct. Their cases allow the following conclusions:

1. In two cases with a lesion of the nuclei of Goll and Burdach, there is (ascending) degeneration of the fillet; the degeneration cannot be followed beyond the subthalamic region and the inferior part of the optic thalamus.

2. In three cases the fillet is destroyed in the region of the pons. The consequence is a descending degeneration, involving the inter-

olivary stratum on the same side and the arcuate fibres and nuclei of Goll and Burdach of the opposite side,—and an ascending degeneration, which can be followed only as far as the anterior corpora quadrigemina and the inferior part of the optic thalamus, but leaves completely intact the fibres passing through the lenticular nucleus, the nucleus of Luys, the globus pallidus and the commissure of Meynert.

3. In four cases lesion of the region of the optic thalamus is followed by a slight atrophy of the mesial fillet, diminishing downwards as we approach the nuclei of Goll and Burdach. This atrophy belongs in the category of "atrophic cellulipète," described by Forel. There is no reason to believe that the cells of the fibres that atrophy apparently downward must be located in the thalami; at any rate, most of the fibres of the fillet come from the cells of the nuclei of Goll and Burdach.

4. Among the nineteen cases of lesion of the motor and parietal area there is especially one which seems very conclusive. The whole external aspect of the left hemisphere and the orbital surface of the frontal lobe were softened; the central ganglia were, however, not involved. The patient had had right hemiphlegia with total aphasia for eleven years. The secondary degeneration involved: the radiations of the thalamus, of the internal and external geniculate body, the fibres to the pons and medulla, the pyramidal tract, etc., a total degeneration of the internal capsule, of the crus cerebri, the locus niger and part of the red nucleus. With all this, the fillet was intact and also the aura lenticularis. A drawing in Dejerine's *Anatomie des centres nerveux*, Vol. I, p. 180, gives the whole plan of the sensory pathways as it follows from his cases.

Dr. Jakob's paper appeared before Dejerine's and adds another case in favor of Von Monakow's view; his remark, that the central sensory nerve cell might be located in the globus pallidus, cannot be upheld by facts, and does not invalidate the view of Von Monakow and Dejerine, which may be summed up as follows:

1. The periphery sensory element is a spinal ganglion cell.
2. The first central sensory nerve cell is a cell of the nuclei of Goll and Burdach, which helps in forming the fillet of the opposite side, and ends in the optic thalamus.
3. The higher central sensory nerve cell is situated in the optic thalamus and sends its process to the cortex of the parietal lobe.

ADOLPH MEYER.

Beiträge zur Kenntniss des Reichtums der Grosshirnrinde des Menschen an markhaltigen Nervenfasern. THEODOR KAES. Archiv für Psychiatrie, XXV, 695-758 Tafl. XIII, XIV, Berlin, 1893.

Ueber den Markfasergehalt der Grosshirnrinde eines 1 1-4 jährigen männlichen Kindes. THEODOR KAES. Jahrbücher der Hamburg Staatskrankenanstalten, IV, 1893-94. Hamburg und Leipzig, Leopold Voss, 1896.

Ueber Grosshirnrindenmasse und über Anordnung der Markfasersysteme in der Rinde des Menschen, zugleich ein Beitrag zur Frage: Unterscheidet sich die Rinde des Kulturmenschen von den niederen Racen in Bezug auf Kaliber, Reichthum und Anordnung der markhaltigen Nervenfasern? THEODOR KAES. Wiener Med. Wochenschr., 1895, No. 41 and 42.

Every attempt to discover the physical basis of intelligence in the gross characters of the brain, its size, weight, form or convolu-

tion, has led to no definite result. If such a basis is to be discovered, it must be sought in the minute structures of the cortex itself, and of all the cortical elements, possibly none could serve the purposes of an index so well as the medullated fibre plexuses chosen by our author. We may see the reason for this selection in the fact that as nerve fibres become functional, they become medullated, hence medullation may be taken as a fair measure of functional nerve paths, afferent, efferent, and associational, within the gray matter.

The methods employed are given in the first paper. The brain is partially hardened in Müller's fluid, then cut into twelve transverse slices of equal thickness; the hardening is completed in Müller's fluid and alcohol; a number of samples are taken from each slice, sections cut and stained by Wolter's (a modification of Weigert's) method. About 100 regions are examined in each hemisphere.

The first paper deals with the results obtained from the study of two brains, respectively eighteen and thirty-eight years old, from males dying of phthisis, this latter disease being selected because mental faculties are so well retained to the last. His gross result leads Kaes to differ decidedly from views usually accepted as to time of medullation of the cortex. Edinger states that differences of medullation cannot be followed after the third year; Obersteiner, that medullation seems to be about complete by the seventh year, while Kaes considers his results to prove that between the eighteenth and thirty-eighth year the medullation of the cortex has made enormous strides — "*noch gewaltig fortschreitet.*" It does not seem to occur to him that these differences may be accounted for by a great number of factors peculiar to the individuals other than age.

The study of fibre content of the infant's brain, as well as of all those that follow, was made by the same method, and is of especial value as giving us the different layers and plexuses in the process of forming. The brain weighed 1030 grammes, a little more than average for a child between one and two years, as usually stated. The author first discusses macroscopic methods of investigation. The color of the cortex will not serve, as in adults, where colors range from yellow through yellowish gray to gray, because the child's cortex is almost uniformly yellow. The color of the medullary core of the convolutions gives some insight into unfolding of a child's brain. In adult brains this stains black and deep-black, while in the child the tints vary from bright-gray, gray, dark, to black and deep-black. The relative percentages of these tints show that medullation (Projection+Meynert's Fibræ Propriæ) in the right hemisphere has proceeded farther than in the left. Comparison of mass of whole cortex and of different layers for the convex, median and under surfaces of a child's brain with that of eighteen-year and thirty-eight-year brains shows that the thickness of the cortex is greater in the child, which is due to the fact that the medullary substance is still growing up into the gray matter. The cortex in the sulci develops more rapidly than at the sides and top of convolutions. Thickness of cortex is greatest, however, on top of the convolutions and least in the sulci. In average breadth of projection bundle, medullary axis of the convolution, the child falls short of the adult by a small fraction of a millimeter. For details of development of different cortical layers, the original must be consulted. In all respects, the right hemisphere is better developed than the left. In this respect, the right convex surface leads, the occipital convolutions coming first, the central ranking next. Results of investigation of fibre content of different layers cannot

be briefly stated. The author considers, however, that the projection fibres form a fixed point, about which the whole central association system is built up. The Fibræ Propriæ antedate all other fibres in medullation and are prominent in regions otherwise poorly developed. In conclusion: The right hemisphere is more advanced in fibre development than the left, while in the adult the opposite is generally true. Right-handedness and the development of speech centre of the left hemisphere are given as reasons for the ultimate left-brainedness of adults. The right occipital region remains better developed because the bilateral use of eyes has not discriminated against it. Regions of the child's brain richest in fibres are the central, especially paracentral, with the occipital next in order; while the region poorest in fibres is the anterior part of the under surface near the insular convolutions. The report, besides charts giving fibre distribution in the cortex, contains several drawings of parts examined.

Too much importance seems to be given to the right-brainedness of the child. May not the case be exceptional, a tendency to left-handedness accounting for this variation? The reasons given for later prepotency of the left hemisphere, speech and right-handedness, seemed almost question begging, for we should naturally suppose that both of these must be determined by superior development of the left hemisphere.

In the last paper some inter-racial comparisons are made, the basis of which is the following series: The brains of eight male Germans, aged respectively 1¼, 18, 38, 41, 42, 45 (two) and 53 years, and one Hindoo and one Chinese, both male and aged about 40. Measurements of cortex, medullary substance and of each fibre plexus in the cortex are carried out with great precision and described in detail for each location. It is shown that the thickness of the cortex is greatest in a child. Decrease in thickness shows on the convexity until the eighteenth year, and on the other two surfaces until the thirty-eighth year. Later, there is an increase, which culminates about the forty-fifth year. At a given age the meagrely fibred parts of the cortex are thicker, while those regions rich in fibres are thinner. Of the dimensions of particular parts of the cortex, the author gives chief attention to the two groups of superradial and interradial fibres, respectively. While the interradial plexus in all three surfaces of the child's brain has reached almost the greatest thickness, which appears stable from thirty-eight years onward, the superradial system shows constant growth from eighteen to forty-five years, but does not continue beyond fifty. After discussing the relative distribution of the fibres in the two hemispheres, the author reaches the general conclusion that the cortical development from childhood to extreme age, for the whole cortical thickness as well as for the medullary substance and for the particular layers of the cortex, may be determined with great precision. As for the medullary substance, the greatest thickness corresponds to the most powerful fibre development. For the association systems of the cortex, the reverse is true. The stronger association development is connected with the thinner cortex. In adults the left convexity is thinner, but is richest in fibre development. The fact that the right is most strongly developed in the child accounts for the brief period of facility in use of the left hand, which, in the author's opinion, immediately precedes the prepotency of the right. Comparison with the Hindoo brain (average of Germans does not include the child's brain) shows that the thickness of the medullary core of the convolutions is less than in the Germans. This is true only of the under surface in the Chinese

brain. In general thickness of cortex, the Germans and Chinese are more nearly alike, while the Hindoo in both hemispheres approaches more nearly to the dimensions in the child. In superradial fibres, the Asiatics are behind the German average. Interradial fibres are about the same, or perhaps somewhat more developed in the Hindoo. The following seems to be the rule: The less a part of the cortex is developed in regard to fibre content, the more nearly the same are the averages of German and Asiatic. Smell and taste centres in *Gyrus Fornicatus* show less fibre development in the Germans than in the Asiatics. The chief difference between the Germans and Asiatics is perhaps as follows: The Chinese and Hindoos show luxuriant growth of interradial fibres, while in the Germans the more vigorous growth appears in the superradial fibres.

We are indebted to the author for a vast amount of work very carefully done; but from individual differences, which appear in his tables, we should think that general conclusions as to brain growth at different ages, and characteristic development of different races had better be deferred until a much larger number of brains have been examined.

E. H. LINDLEY.

The Sense Organs of Lumbricus Agricola (Hoffm). FANNY E. LANGDON. *Journal of Morphology*, XI, 194-232, Pls. XX, XIII and XIV, 2 Figs. in text. Boston, 1895.

In the total absence of any definite type of sense-organ, the sensitiveness of the earthworm to such various stimuli as light, taste, smell and touch has remained a standing puzzle. The older writers, beginning with Leydig and Schulze, and coming down to Mojsisovics and Ude in more recent years, did, it is true, give some ground of hope that the problem might find a solution in the discovery of a definite organ. Their authority, however, was about balanced by other investigators, who failed to find any trace of either structure or grouping indicative of special sensory functions among the epidermal cells. The matter seemed closed, when both Retzius and Lenhossék, employing most approved methods, declared against the presence of definite sense-organs. In the face of these authorities, however, our author is able to clear up the subject in a way that can leave no room for doubt.

The sense-organ of Lumbricus is shown to consist of a number of ganglion cells, arranged in oval groups very much like taste buds. From the distal end of each cell a sensory hair perforates the cuticle to the exterior, while from its central end arises a nerve fibre which passes with the sensory nerve trunk into the ventral ganglion of the same side and segment. The size of the organs, 100 by 60 μ, as well as their number, averaging 1,000 to each segment, make it doubly remarkable that they have been overlooked so long. Plate XIV presents us with camera drawings of the sensory spots as seen on the cuticle of a specimen for characteristic metameres. From this it appears that the organs are in general scattered irregularly over the surface, somewhat more numerous on the cephalic than caudal half of the segment, and more numerous near the extremities than in the middle of the body. No differentiation of organs for different senses has been made out.

The paper is compactly and clearly written and well illustrated, and in every respect merits high rank in the literature of comparative sense-organs. C. F. H.

II.—ASSOCIATION AND PERCEPTION.

Ueber das Grundprincip der Association; Inaugural Dissertation. By ARTHUR ALLIN, M. A., PH. D. (Mayer u. Müller, Berlin, 1895, pp. 84.)

The attempt is here made to assist in the reduction of the different laws of association to one, viz., the Law of Contiguity. The claims advanced by the supporters of the Law of Similarity are largely based upon what may be called the "Recognition Theory" of perception upheld by such a long succession of noted thinkers as Empedocles, Democritus, Kant, Herbart, J. S. Mill, Bain, Spencer, Sully, Wundt, Ward and Höffding. A refutation of this theory is therefore attempted. Paradoxically put, the theory asserts that all cognition is recognition, *kennen* is *wiedererkennen*, *connaître* is *reconnaître*. In every perception, the sense-impression of the object is said to call up by association through similarity a former image or memory picture of the same. These two are said to "fuse," "identify" and "recognize" each other, producing thus a "known" object. This process is held to take place in all perception, in fact in all cognition. Thus, this process of association by similarity is said to be the necessary presupposition of all association, including, of course, the Law of Contiguity. As Höffding has been of late the chief promulgator of this doctrine, he has been selected as chief exponent.

The following objections are urged against the theory. For their substantiation the reader may be referred to the article, "The Recognition Theory of Perception," in this number of the JOURNAL:

1. *Perception is not, as stated, an act of memory.*
2. *Perception does not, as stated, involve comparison.*
3. *Perception does not involve the so-called process of "psychical chemistry."*
4. *In perception there is no "revival of former impressions."*
5. *The Bekanntheitsqualität ought, on Höffding's own grounds, to belong to the sense-impressions as much as to the "revived images."*
6. *The theory gives a false description and no proper explanation of abnormal perception, i. e., sense-illusion.*

The Recognition Theory of Perception having been found to be utterly untenable, the Law of Similarity is forced to retire from the field of perception. The nature of perception is investigated and shown to involve, on the other hand, the Law of Contiguity, *i. e.*, on the neurological side. On the psychical side an object is given as one (peripherally-excited) whole (*a b c d*). In ordinary perception we believe we perceive (as sensationally given) the whole (*a b c d*). On the neurological side it is shown that *a b* is peripherally excited, and that in all probability the nervous impulse underlying *a b* is propagated to the centres underlying the psychical *c d*. Psychically it is one whole; neurologically it is the process underlying association by contiguity. Abnormal perception or sense-illusion takes place when, on the neurological side, the nervous impulse involved in the *a b* is propagated along another associational path *e f*, thus forming on the psychical side the whole (*a b e f*). Thus the author reads the abbreviaton "*Abltg.*" as "*Abtg.*," *i. e.*, because one reads "*Abtg.*" so often for *Abtheilung*, one is apt to read "*Abltg.*" (*Ableitung*) also as "*Abtg.*" Another example: In the evening twilight, on a lonely road, the traveler perceives a robber. Upon nearer investigation the external object is found to be the stump of a tree with gaunt, outstretched limb.

The explanation is the same. The true explanation of abnormal perception thus throws light on normal perception.

The Law of Similarity is also shown to be non-operative in recognition proper (*vide* the article "Recognition" in this number).

The prevalent teaching concerning "Assimilation" (Wundt, Bain, Mill, Dewey, *et. cet.*), is shown to be incorrect and contradictory to the facts in as far as it is said to involve the action of a law of similarity.

The different meanings and grades of similarity are taken up and shown to be unclear and confusing. The different cases of alleged association by similarity are shown to be analyzable into cases of association by contiguity.

The Law of Interest (Hamilton) is then examined in reference to and as an integral part of attention. ARTHUR ALLIN.

Ueber den Einfluss von Gesichtsassociationen auf die Raumwahrnehmungen der Haut. Von MARGARET FLOY WASHBURN. Erweiterter Abdruck aus Wundt, Philosoph. Studien, XI Bd., 2 Heft. Leipzig, 1895, pp. 60. Doctor's Dissertation, Cornell University, 1894.

The important thesis which this paper supports is that the localization of tactual sensations in persons of normal powers of visualization is not immediate, but to a greater or less extent by means of visual associations. In other words, when asked to locate a point of the skin previously touched by the experimenter, the subject does so by means of a visual map of the part of the body in question. The fullness and accuracy of the visual map probably differ from man to man and for different bodily areas in the same man, areas which present strongly marked foldings of the skin (as at the joints) or the boundary lines of the members being represented with particular clearness and detail.

The first part of Miss Washburn's study is devoted to a careful survey of important literature from Weber (who seems once to have almost had this idea) through Czermak, Goltz, Volkmann, Vierordt's pupils, Fechner, Camerer and Goldscheider to Henri. In this the new conception justifies itself again and again by its power of explanation. It gives a reason "(*a*) for the greater distinctness of horizontal distances on the extremities as compared with vertical (Weber); (*b*) for Volkmann's observation of the rapid progress of practice and its bilateral effect; (c) for Camerer's observation that the equivalence relation between two parts [as determined by his method] approaches nearer to unity than that established between the same parts by other methods; (*d*) possibly also for the results of Henri's experiments with localization on a photograph, which show that the localization error on the hand and wrist is smaller in the neighborhood of the folds and always occurs in the direction of the nearest folds." It also seems probable that visualization combined with anatomical conditions accounts for the greater sensitivity of the smaller parts of the body (according to Weber), or the more mobile parts (according to Vierordt), and for the superior discriminative powers of children observed by Czermak.

The second part of the paper contains the author's own experiments. These were made upon five subjects, two who were good visualizers, two whose powers were only moderate in this direction, and one, a woman of fifty, who had been blind since her fifth year, and who thus furnished an interesting counterpiece to the normal subjects. An apparently unavoidable difficulty in approaching the matter experimentally lies in the im-

possibility of getting on the same individual results both with and without the visual component. This is partly met by the experiments on the blind subject, but robs those on the other subjects of some of their directness. The results, however, are in general satisfactory. For details the reader is referred to the original. Volkmann's bilateral effect of practice was not found, possibly because the experiments on this point were not numerous enough and long enough continued. The bilateral effect was strongly marked in the experiments of Dresslar (this JOURNAL VI, pp. 325 ff.). Of incidental observations the following are interesting: the duality of the stimulus in Weber's circle experiments is easier to recognize than the relative direction of the points; the direction is better recognized when a straight edge of length equal to the separation of the points is substituted for them; the blind subject tended to underestimate the breadth of her arm as compared with its length—an effect possibly due to muscular associations.

The third part of the paper is given to a discussion of the psychology of the methods employed, and contains interesting observations on the effect of expectation and of the introduction of blank experiments (*Nullversuche*), *i. e.*, tests whose object is to assure the operator of the state of the subject's attention.

That some such intervention of visual images as the author describes does take place in his own case, is clear to the introspection of the reviewer—certainly in cases where the grade of attention is high. The only wonder is that what seems so obvious and important should have been missed by the many distinguished investigators who have previously worked upon skin sensations. The author refrains from extending her principle of visualization beyond skin sensations, but it doubtless has a much wider scope. In experiments in the Clark laboratory made in the spring of 1895, and upon quite another topic, it incidentally appeared that visualization affected the subject's notion of his posture. The question naturally suggests itself whether there are not other vicarious functionings among the senses, and in general what the mutual relations of the senses are. Indeed, Miss Washburn's suggestion is so wide in possible development as almost to promise a new chapter in experimental psychology.

E. C. S.

Die Umwälzung der Wahrnehmungshypothesen durch die mechanische Methode. Nebst einem Beitrag über die Grenzen der physiologischen Psychologie. Von DR. HERMANN SCHWARZ. Leipzig, 1895, pp. xx-213.

This work consists of three treatises, related to each other only by the fact that they deal with theories of perception. The first — "*Das Problem des unmittelbaren Erkennens*" — traces the development of the general problem of perception from Democritus and Aristotle to Descartes and Hobbes. The second — "*Das Problem der Sinnesqualitäten*" — gives a discussion of the theories of the perception of sensory qualities in Hobbes and Descartes, as compared with the theories of the Greeks and scholastics. The third — "*Ueber die Grenzen der physiologischen Psychologie*" — is a critique of Exner's attempt to explain consciousness on purely physiological grounds. Although not logically connected, the arguments of the first two parts are so similar that we need not give them separate treatment here. Both alike trace the development of perception from the Greeks to Hobbes.

Dr. Schwarz divides epistemological theories into two groups: theories which make all perception perception at a distance (Aristotle), and theories of perception by direct contact (Democritus). The whole tendency of the development of the problem in mediæval and modern philosophy is considered as an attempt to reduce perception at a distance to perception by contact. Much space is given to the attempts of Thomas, Suarez and Biels to get an intermediation between subject and object by means of the hypothetical "species." Stripped of their picturesque, mythical forms of expression, these accounts really mean that the qualities of the external object are in some way transferred to the mind, but that at the same time the object itself is known, and not merely its qualities. With Descartes and Hobbes mythical statement gives place to a mechanical construction. The whole process must be capable of clear statement, in terms of familiar mechanical processes. But the problem still is to obtain some means of intermediation between the object and the mind. And all the theories treated are alike, again, in the fact that they make the intermediaries themselves mere representatives of the external objects: we never know them, but only the objects through them.

The discussion of these theories is very clear, though often clear at the expense of brevity. Some pages are wasted by repetitions, in the second part, of matter already given in the first; but this is accounted for by the fact that the two treatises were written independently. Besides the development of the main argument, many minor problems incidental to the main theses of the various systems are examined with much acuteness, and many grave difficulties in the way of the unity of the several theories satisfactorily removed.

By far the most important of the three articles for the psychologist is the third, the discussion of the limits to the use of physiological processes in explaining psychological phenomena. Dr. Schwarz traces the development of the relation between physiology and psychology through three stages. In the first, the physiologist makes use of psychological elements in drawing his most general distinctions, of animate and inanimate object, and of plant and animal. The physiologist next frees himself from this dependence on psychology, and gives all his explanations in terms of bodily processes, without reference to mental. In the third stage, the present, the psychological is made dependent on the physiological. In this final form, physiological psychology seems to have no need of an introspective foundation. According to Exner, the lower centres determine the activity of the higher, and these in turn condition consciousness. There is no reverse effect, *i. e.*, consciousness has no effect upon the physiological processes. Furthermore, we cannot arrange a causal series of the psychical elements which shall be correlated with the causal series on the physiological side; since the more remote members of the physiological series, the activities of the lower centres, are entirely unconscious. It would appear, then, from Exner's theory, that introspection can give no aid in psychology.

If, however, this explanation is to suffice, it must stand two tests. First, can we readily state the ordinary psychical elements in physiological terms? And, conversely, can we apply the ordinary psychological terms to physiological processes? Exner's explanation, in terms of intensity and localisation of cerebral activity alone, seems to break down in both respects. When reduced to their lowest terms, Exner's sensations are three-dimensional entities; they have intensity, extensity and quality; while his physiological excitations have only two dimensions, intensity and place in the

cortex. This argument becomes still stronger if we add feeling to sensation as a peculiar process. And the difficulties appear yet more clearly when we try to translate our physiological processes into psychological terms. We must assume a conflux of cortical stimuli as the substrate for all complex mental processes. It must be supposed that we have only increase in intensity and extent of stimulation, as we pass from perception to idea and judgment. No sharp line can be drawn between them, in terms of their physiological substrate. No distinction can be made between the nervous excitation at the basis of analysable and unanalysable complexes. Both difficulties seem insoluble from the physiological standpoint.

This criticism would be unanswerable if we interpreted Exner's statements literally. But it is difficult to believe that he intends us to understand that there is no difference in quality (form) of nervous excitation, accompanying difference in the part of the cortex stimulated. If understood literally, Exner seems to have overreached himself in his desire to make his explanations as simple as possible. Moreover, aside from their references to Exner's theory, Dr. Schwarz' objections seem to have overlooked Stumpf's theory of a synergy of cerebral functions, as distinct from local association of functions. Nor would it complicate matters much if we assumed (as we surely have a right to assume) a difference of form, as between nervous excitations, and made this a third physiological attribute. We conclude, therefore, that the criticism of the article is not valid. There are possibilities enough in the variations of neural activity to explain all the facts of consciousness. It is only necessary that we should be willing to sacrifice simplicity to adequacy of explanation.

W. B. PILLSBURY.

Die Physiologie des Geruchs. Von Dr. H. ZWAARDEMAKER, Stabarzt-Docent in Utrecht. Leipzig, 1895, pp. 324.

A comprehensive work on smell has long been desiderated, and here at last it is with twenty-eight cuts, a good index and register, and 232 titles on the morphology of olfactory organs among vertebrates, and done withal by a student of the subject whose previous brief communications on the subject justified high expectations. Although the author has devoted seven years to research in the field, he publishes reluctantly and upon the exhortation of Dr. Junker, his translator into German, in the hope that students "will devote themselves to this attractive field, which still promises rich harvests of surprising facts and hypotheses of wide bearings." The technique of the author's olfactometry and odorometry is most simple. A larger tube, containing the substance to be smelled, is slid up over a smaller calibrated tube, the end of which curves upward to the nostril, the whole being supported on a frame and worked as a syringe. The apparatus may be double, may work by pressure or by suction, and a branch tube to a Marey drum may be attached to mark time reactions. Each mark on the smaller tube measures one "olfact" of intensity, and in graphic fatigue tables olfacts are conveniently marked off on the ordinate and seconds on the abscissa. The author makes nine classes of purely olfactive odor materials. These he thinks of as located in the olfactory region, so that the energy zones corresponding to the nine classes are marked off by vertical lines, while within each zone is a scale designating the series of an homologous sequence of chemical combinations, these lines being curved to correspond to the curve of an inspiratory current of air. Each of the hypothecal quality

fields has its irradiation field. By his tables Dr. Zwaardemaker thinks all odors can be classified somewhat as, and about as well as, colors can be located on current color charts. An appendix follows on the chemical sense in lower animals, and another of clinical-neurological methods of measuring smell.

III.—MENTAL DISEASES AND ABNORMALITIES.

Mental Physiology, especially in its Relation to Mental Disorders. By THEO. B. HYSLOP, M. D. London, J. & A. Churchill, 1895, pp. 552.

This work, dedicated to Dr. George H. Savage, is described by its author as "elementary," and as attempting little more than "to bring together some of the more prominent phenomena of the brain and of the mind, both in their normal and morbid aspects." After a discussion of dualism and monism in the first chapter, and concluding that we need not settle the matter, the author passes to a view of the anatomy of the cortex and nerve cells and functions in the second chapter. Then chemical and nutritive functions, brain movements, general anatomy and localization bring him to the study of "mind." Unconscious cerebration, each sense, perception in general, sensory perversions and hypnotism are next discussed. Then, after an excursus on attention, conception, judgment, and imagination in their normal, he takes up their morbid forms. Memory, feeling and will are next treated in the same way, and the best, longest and most interesting chapters treat of the factors of insanity. Appendices on hypnotism and psycho-physics follow. In fine, we have no *physiological* data which give the faintest solution to the problem *how* the positive activities of the mind come to exhibit such endless diversities and infinitely varied relations.

Dr. Hyslop's book is unique in juxtaposing side by side and topic by topic with nearly equal space the elements of normal and morbid mental physiology. We have nothing quite like it. It seems, on the whole, better adapted to use in American college class rooms than any American text-book. It is less theoretical and speculative, and fuller of interesting and fruitful facts and cases. It is well up to date, moderate in compass, avoids subtleties and digressions, and is distorted by no pet theories. It is to-day what its prototype, Carpenter's "Mental Physiology," was in its day, with perhaps, however, relatively more normal psychology. We heartily recommend it to all American teachers and professors. The judicious use of the morbid side of soul life is well calculated to awaken interest, as this always does, but injurious possibilities are eliminated with very wise discretion.

La Confusion Mentale Primitive. Par DR. PH. CHASLIN. Paris, 1895, pp. 264.

The first eighty pages are historic, and part second is devoted to symptoms, psychology and physiology, etiology, diagnostic, prognostic, anatomy, place in scheme of classification and to treatment. At first the highest associations and the most abstract reasonings are affected, but phrases and ordinary acts are conserved, then constellations of images begin to loosen, centres break from their dependence. Words and phrases, *e. g.*, may be logical, but the sentences are incoherent, and at last words and even syllables lose their cohesion, and even the most elemental associations are affected, till the patient cannot orient himself in time and space and dissociation, and decomposition is extreme. Of course

the same process may occur in motor images, and acts may become incomplete and confused. It may be semi-dreams, transitory amentia, subacute neurasthenia, and may involve abated responsibility. There may be delirium, hallucination, agitation, inertia, emotional variations, or any of these may be absent. Of its pathology little is certain, but it is probably largely somatic, while its treatment is largely moral.

Contributions à l'Étude des États Cataleptiques dans Les Maladies Mentales. Par DR. PAUL LE MAITRE. Paris, 1895, pp. 96.

On the basis of fifteen cases and with an excellent summary of the literature (of which a comprehensive bibliography is appended), the author holds in substance: that cataleptic states which develop in the course of psychoses are often slight, brief and partial; that with increase of muscle tension and enfeeblement of voluntary psycho-motor activity they are often due to enfeeblement of perception of fatigue and to the persistence of communicated motor-images; they may develop in a number of mental maladies, especially in alcoholic delirium, melancholy, mental confusion, manias, periodic insanity, the delirium of degenerates, and in congenital or acquired mental feebleness; they may precede or follow an epileptic crisis; hysteria is rarely connected with them; there is no katatonia of Kahlbaum; and these states are easily simulated.

Les États intellectuels dans la Mélancolie. Par GEORGES DUMAS. Paris, 1895, pp. 142.

This modest little book is mainly a study of ideas among melancholics, and to base a determination of its forms on such a study. His main conclusions are three: I. That melancholy is not a mental entity, but is made up of phenomena of sensation and those of arrest. II. It may have an intellectual or an organic origin, but in both cases the motor precedes the sensory phenomena, and it is always only a consciousness of body-states. III. Synthesis is the law of ideas, images or mental states, which are associated with the conæsthesia, and this synthesis is logic.

The Melancholy of Stephen Allard. A private diary. Edited by GARNET SMITH. New York, 1895, pp. 305.

At the age of thirty Stephen Allard says he fled from Vanity Fair and took refuge among the hills to find consolation in nature, to rediscover his personality, regain unity, to read clear his heart, to find how to bear himself in this prosaic, mysterious world, to strive toward quietness, etc. He had learned to doubt, and felt sorrow, and had grown solitary while at Oxford, had felt himself well endowed with half-talents, but could not breathe in the arid heights of philosophy, and became a baffled thinker, a bankrupt idealist. As he had only latent faculties, and owned nothing the world cared to purchase, he tried to drug himself with literature. Education he had found only a rude struggle for prizes, a hoarding up of answers to questions that did not interest him, till he recognized unpalatableness as the criterion of truth, and science seemed a nightmare. Then he fell in love with Guerin, that victim of self-analysis and of morbid egotism; then Obermann, Musset, Schopenhauer, Lenau, Lucian, Hegel, but found no consolation. Then he tried action, but the actions of literary men; then love, but regarded women only as pictures, some more, some less fondly; and loved the beautiful, but even it was sad; so the thoughts of im-

mortality, stoicism and epicureanism were tried, till at last nature was found the best of all sinapisms.

Part II finds ennui the malady of the century, and his is the ennui not of feeling, but of thought. Both realism and idealists are products of melancholy, because of their abandonment of higher views. German philosophy, as a sort of pride in truth, has no cheer for the author, nor simple faith in letters. The purely autonomous sages are most serene, and the evolutionary Utopia is a tolerable halting place. Ecstasy, humanism, æsthetic and metaphysical religions, drama, music, mysticism were tried. Once he thought he found peace in self-renunciation, but the depression returned with almost suicidal intensity, and the book ends abruptly.

Allard we opine to be a lay figure, to whom the author ascribes his lucubrations. He must have been an omnivorous reader, but a superficial one, and the moral of this confession, if one can be psychologized from it, we suggest to be the unsatisfactory nature of voluminous but desultory reading. A mind that is like a well used sheet of blotting paper is a sad spectacle to others and must be unsatisfactory to its possessor. It is not a very remarkable work of genius.

The New England Invalid. The Shattuck Lecture for 1895. By ROBERT T. EDES, M. D. Boston, 1895, pp. 57.

The New England invalid, who "needs only to be built up," has a symptom for every organ, and no specialist can escape her. If the old physician gives her up, she bestows herself on the young. "The physician cannot dispose of her to the surgeon, for after her braces have given out, after her spine has been shortened by a vertebra or two, after her pelvis and her pocketbook are alike empty, she comes back." But it is the modern sisters and husbands who hear most of the functional irritations, distresses, the burnings, the flutterings, the quiverings, the throbbings, the tensions, the relaxations, the reproaches for indifference, the accusations of selfishness and the more trying repentance therefor, the ostentatious resignation of the misunderstood, the sympathy which they crave, the constant outflow of nervous force for which there is no adequate re-supply in a confident hope of recovery, who suffer and know most of her. The types described are: (1) the malingerers pure and simple, who feign disease out of whole cloth, with deliberate intent; (2) the exaggerators, honest but whimsical, silly and self-indulgent; (3) the constitutionally neurotic; (4) the hysterically excitable; (5) the neuromimetic; (6) the confirmed neuromimetic; (7 and 8) the tense and the limp neurasthenic; (9) the melancholic. While there may be something in the doctrine of the curative effect of surgical operations *per se*, removal of healthy ovaries rarely cures these cases. The lithæmic doctrine of uric acid, headache, or suppressed gout, does not show that there is not another neurasthenic headache. Some of these patients have a good blood color of even 80 per cent. Fleische, so anæmia is not always the cause. Next to those of no occupation, teachers and students supply most invalids of this type. The excessive New England conscientious school methods which make pupils "bite off more than they can chaw," and especially examinations, are in part responsible. The author differs from Dr. Cowles' view that melancholy is a further development of neurasthenia, by holding the form to be a self-limited disease with beginning, middle and end, although sometimes becoming chronic. The figure which compares neurasthenia to a bank account constantly drawn on

without corresponding deposit, is exceedingly erroneous in "implying that no matter how low the account may go, it can be set right again at once by a single sufficient sum." If the patient has pride in the obscurity, difficulty or patience of her own case, as if saying to the doctor, 'I defy you to cure me,' then very pride must be turned in the direction of holding her recovery to be phenomenal, or her strength and elasticity great. We must learn many secrets of psychic treatment from charlatans.

Abnormal Women. A Sociological and Scientific Study of Young Women, etc. By ARTHUR MACDONALD. Washington, D. C., 1895, pp. 189.

The author studied philosophy and allied subjects in Europe for several years on a Harvard fellowship, and was later docent in anthropological psychology in Clark University, and for the last few years has been in the Bureau of Education in Washington. He has published books of considerable size: "Abnormal Man," "Criminology," and "Le Criminel-Type," and made many anthropometric measurements of children, and has traveled extensively in this country and Europe in quest of data for his investigations. Mr. McDonald appears to hold, with men like Krafft-Ebing and Lombroso, who have perhaps chiefly influenced him, that certain delicate themes are in crying need of investigation.

To find abnormal women in society the following advertisement was inserted in the personal column of a number of the principal newspapers in the large cities of our country: "Gentleman of high social and university positions desires correspondence (acquaintance not necessary) with young educated women of high social and financial position. No agents; no triflers. Must give detailed account of life; references required. Address Lock Box —." The book consists chiefly of letters and accounts of eighty-eight "cases" who replied to this advertisement, all names and most places being, of course, omitted. As the correspondents, mostly young women of refinement and education and undoubted respectability, "lived in all parts of our country, mostly in large cities, and some in Europe, the probability of any of them being identified is practically *nil*. It is difficult to see any serious reason why people in general should object to being studied, for the name of person or place is of no account." Some "gave their name and address in their first letter, illustrating the credulity of young women." The author's reply requested them to tell all about themselves. Those he was able to call upon were tested with delicate instruments of precision as to "acuteness of the nerves to heat, pain and locality." From these experiments the author inclines to the view that the cause of their disposition to answer "personals" was due, not so much to the nervous condition as to the fact that most are out of harmony with their present social environment. Most of these women have nothing special to do in life. The number that have traveled in Europe and speak more than one language is striking. These seem least able to focus, and soon tire of everything. Some answer at once; some think it over a week or more; some answer to escape monotony; some love mystery; some for curiosity; some to give the author a moral lecture. As a whole the letters are of exceeding interest and significance to the psychologist and sociologist. Some of them are brilliant literary products. It suggests wrong or defective education. The author's very brief pages at the close of the book are unsatisfactory, and do not, to our thinking, bring out at all adequately the lessons of these painful yet interesting pages. G. S. H.

Doctor Judas. A Portrayal of the Opium Habit. By WILLIAM ROSSER COBBE. Chicago, 1895, pp. 320.

This book is dedicated "to my wife, who, innocent, suffered most for my transgressions, and in grateful recollection of her gentleness, forbearance and love throughout the long night of opium slavery," and its motto is, "Opium is the Judas of drugs; it kisses and then betrays." The author writes his book from a pure sense of moral obligation, and has never given a thought to how it would be received. His habit was based on opium cordials given him as a child to quiet his cries by the advice of physicians, and, at the time of writing, he had been eighteen months freed from thraldom to the drug, after nine years of abject slavery. He inherited sensitive weakness, read sombre books as a child, resolved to enter the ministry, at seventeen was a skeptic, but later did chaplain duty in the navy. At the end of his slavery his body was pricked as by ten million needles, his knees smote in agony, every joint was racked with a consuming fire. The most truthful man will lie when in any stage of addiction to the opium habit, he says. Fears of death and suicide impulses were strong. Loquacity, abstraction of memory concerning the most common things, fits of personal excitement when everything seemed possible, spells of dreamy reverie, sounds in the ears, etc., were common. De Quincey is wrong in denying a tendency to increase the drug, that the drug's power declines with use, in ascribing the depression of spirits to "sedentariness" and not to the drug, and in saying that the drug added thirty-five years to his life, and that he decreased his daily dose. In all these respects Mr. Cobbe's experience is contrary to that of De Quincey, whose falsely attractive description of its effects has caused the opium habit in thousands of cases among the best classes. Much, he says, is in short an opium lie. The stages are: cessation of pain, voices clearly uttering distinct sentences, double and distorted vision. Laudnum phantasmagoria, insomnia, semi-cerebration, horrified and fantastic night dreams, visions of battles and judgment in a crescendo series are described. Just what the good angel in human form was that cured him, we are left in doubt. On the whole the book adds little to either the medical or literary contributions. The language is superlative, the book is rather incoherent and tedious, and whether the work of a genuine victim of the habit or not is likely to be most useful as an appeal to other victims. Even these, however, will chiefly miss the practical details of the cure and its causes.

Bill Pratt, the Saw-buck Philosopher. By I. S. ZELIE and C. PEREZ. Williamstown, 1895, pp. 121.

This strange character, familiar to the students of Williams College for fifty years, was a man of stalwart frame, rather feeble witted, but with a passion for oratory and a sense of oratorical rhythm that were of remarkable psychological interest. His good nature was boundless. For any student he liked, or for any small group, he would stop sawing wood and pour forth a volume of impassioned oratory, which, despite its incoherence, his great physique, and voice, and vigorous action, made impressive, and which would impress any one just far enough away not to hear the words, as the intonations and cadences of a consummate rhetorical climax. His flights were always brief, and generally ended in a sudden drop to bathos, which seemed to gradually develop as his defense against the derisive element in the uproarious applause which followed. One or two illustrations must suffice. The follow-

ing is an impromptu funeral address delivered one day and stenographed in front of West College, just after a funeral procession had passed: "Murmur and mourn! The language of life is past. The grass of gullery is gone, and the electricity of the bay-rum tree is decided with the laments of refuge. Oh, he was a good man. How the grasshoppers of his belief floundered with the winds of his whiffle-trees. What a burden he was! What a beautiful Pharisee! By the corduroy of his attainments and the melody of his magnificence he retired, and the palms of his pussy-willows wave with the rolling Ottaw." To a theological graduate on his return to the college, whom he met on the street, he orated thus: "You have the gloomy shines. Worn with a tumult of the conflict of Hebrew and a scrutiny of salvation, are you consumed with your mountainous circumstances? Are you deprivated? No, sir! Why, sir? Because you have regulated your eccentricities, and you now have a coherent ideification." Of the clergy, he said: "They are men of deprudence. They have walked the verges of life with a crucifixion of memory. They have hibernated among the sanctified symptoms and a confession of matrimony. Oh, the catechism of chief end of man. How they have walked the verges of life with the carbolic acid of depression," etc. Sometimes in these flights his eyes were closed and he seemed as if mentally belaboring his theme with intense abandon. If there is such a thing as an innate vein of genius for oratorical rhythm, a pure declamatory instinct, it was found in Bill Pratt. Perhaps, in a more favorable age, he might have been a rhapsodist like Plato's Ion, or a muttering oracular dervish, into whose incoherence it is so easy to read higher meanings. Perhaps, as it was, his perfervid improvisation might have weighed a trifle as a warning object lesson against the spouting diathesis which some teachers of rhetoric in colleges other than Williams sometimes foster. It seems, at any rate, a most interesting psychic background or foundation on which no adequate superstructure was reared.

Die drohende physische Entartung des Culturvölkes. Von W. SCHALLMAYER. 2 Auflage. Berlin, 1895, pp. 49.

Modern individualistic tendencies are at the cost of the race, and the only cure is the application of human reason to the problem of natural selection. Great cities, bad school methods which hurt the nerves, factory life, fashion, the extremes of both poverty and riches, etc., interfere with natural selection. Against all the tendencies to progressive degeneration of soul and body, the author proposes that all physicians should be made state officers, and that detailed "family books," should be kept recording all medical and hygienic facts concerning each member of the family, by a plan to be kept for centuries. Thus future generations can draw certain conclusions concerning the heredity of neuroses, early and late marriages, etc.

IV.—FEELING AND TEMPERAMENT.

Studies in the Evolutionary Psychology of Feeling. By HIRAM M. STANLEY. London and New York, 1895, pp. 392.

"This work," the author tells us, "does not profess to be a treatise on the subject of feeling, but merely a series of studies, and rather tentative ones at that. I have attempted to deduce from the standpoint of biological evolution the origin and development of feeling, and then to consider how far introspection confirms the results." Some of the material of the book has appeared

within ten years in various journals, but all has been revised or rewritten. The author assumes that frank emotionalism is necessary in the struggle of life; that intellect must always be impelled by emotion, either personal or impersonal, like duty or love of truth. Feeling is the basis and core of mind, actuating both will and cognition; cannot be destroyed, but must grow ever stronger, deeper, nobler. Mind begins in pure pain, and culminates in the higher emotions. Its expression crystallizes into language, and even causes the rise of objectification. The number of names of feeling is but a very rough index of the number of kinds of feeling, for which the psychic chemistry of the future will develop names. The unnamed forms far exceed the named, and the number of indiscriminated or undiscovered feelings far exceeds both. Consciousness is indefinitely complex, and the system-making psychology is factitious and delusive. The number of unknown psychoses is, perhaps, almost infinite. Science, art, ethics and religion are at bottom only phases of emotionalism. Other as valid and essential expressions are yet to be developed. The activities of new born animals seem spontaneous only because they are the results of energies stored in ages of psychic effort. The effort to see has produced the optic nerve. The confusing of objective and subjective terms, of inspection and introspection is responsible for much of the present confusion. The limitations of the author's introspective method are fully realized, and there is a despairing note in the last chapter concerning future progress.

The best chapters are those on fear and anger. The former is a primitive emotion, and is pervaded by anticipation of the primitive feeling of pain, but the pain in fear is not wholly revival. If intense, it tends to vanish in the sensation feared. When it declines, it repeats the stages of its growth, but inversely. Fear is "a feeling of reaction from the representation of the feeling potency of the object." "Only introspective analysis can reveal the true motive and genesis of fear and all emotion." But here, as so often in this book, the reader is brought up with the idea that will obtrude, that if introspection is the method, and this is all it can do, we may well despair. How, too, does he feel sure that his series, fright, alarm, terror, dread, horror, is the "chronological order." Anger is the stimulant to offensive reaction as fear is to defensive. It implies a "sense of object," it has an element of "hostility."

On the whole the author deserves praise for admitting the biologic factor in feelings—but his recognition of its scope seems sadly inadequate. His method paralyzes him in this field as in no other. Psychology finds the emotional realm so hard to enter, only because of the amphibious dualism pervading the text-books of the past decade. In some minds this has become a positive neurosis. It obtrudes its double housekeeping upon minds natively sound and ingenious and may cause an ebullition of brilliant ratiocination, like salt on flames. It often repels from philosophy or sterilizes the very central buds of mental and moral growth, and clips the wings of minds, which, like this author, by nature and by interest in the subject, seem fitted to enter these fields. We took up this book with great expectation, but lay it down, not without being much instructed and stimulated, but with a predominant sense of disappointment. G. S. H.

Tempérament et Caractère selon les Individus, les Sexes, et les Races. Par ALFRED FOUILLÉE. Paris, 1895, pp. 378. In Felix Alcan's Bib. de Philos. Contem.

This gifted and facile author enters here a field of great interest,

to which he makes contributions of high value. The sensitive temperament is sub-divided into that with prompt and that with intense reactions, and so later is the active temperament. Actives, who are prompt and intense, are not unlike the old choleric, and those slow and feeble are like the old phlegmatics. Characters are classified as *les sensitifs*, *les intellectuels*, *les volontaires*. The last and larger half of the book discusses difference of temperament, character, of sex, and of different races of man, with a final glimpse at the future of superior races. Recent biological studies show a very intimate union between character and temperament. The reactions of will, which is increasingly intelligent, upon our inner constitution are what evolves character. These studies are not made on the hypothesis that character is immutable and that therefore morals are useless save for weak characters. The author discusses whether character is reducible to molecular mechanics, or a neural tone, as Henle says; whether feeling and action strengthen or weaken each other; whether the disposition of nervous people to melancholy is due to too little voluntary movement compared with sensations, etc. He defines the sanguine temperament as marked by integration predominant, by excess of nutrition, with quick but feeble and brief reaction; the nervous is sensitive and passionate, with lack of nutrition, with slow but intense and long reaction; the bilious is marked by rapid and intense disintegration, and the phlegmatic is marked by slow and feeble disintegration. Schools might gain by grouping these temperaments by themselves and applying to each its special methods. Whether there were originally an indefinite number of human races, man does tend to maximize in all his conduct. Thus in history, the good are often the feeble, who have not force enough to be bad. It is more likely that the leading races will overcome the others than that they will mix or develop side by side. Once the race type was all and the individual nothing, then individuality had its maximation. The future will be able to harmonize these two tendencies, if we do not relax effort and trust blindly to our *fin de siècle* deity of progress. The only way to arrest impending degeneration in the highest races is by a vigorous use of intelligent will, and recognizing that science will not make men moral, that culture of art only changes the form of vice, to strive toward a veritable education of character, which is the education of the future.

L'Amitié Antique d'après les Mœurs Populaire et les Theories des Philosophes. Par L. DUGAS. Paris, 1894, F. Alcam, pp. 454.

This is a very interesting, useful and timely book. It appears to be a dissertation, and attempts to give the history of friendship in both theory and fact from the days of its conception as a physical force by Empedocles and Herodotus down to the end of the stoic age among the Romans, with copious and judicious citations, analytical tables prefixed to each chapter, with a digest of the whole, and the literature by chapters at the end. The fact that it is written by a doctor of letters rather than by a philosopher, is perhaps a good thing at a time when the treatment of this theme in current text-books on ethics is so hackneyed and arid, and when the psychology of feelings and sentiments seems coming to the fore. The author seems almost to assume with Taine that history is nothing but the history of the heart, and historic research has done its work when it has given us a picture of the dominant sentiment of an age. Friendship also is, of course, very distinct from love of sexes, love of God and philanthropy, and is one of the chief virtues.

Plato and the stoics were right. Only the good have real capacity for friendship. From the Pythagorean, at least, down through the academy, porch and grove, it was developed among most philosophic schools, except the sophists. So Aristotle's *amicus Plato, sed majis amica veritas* was bold as it was historically important. In the relations between teacher and pupil, friendship has one of its chief, if not its chief, and most desiderated fields. It must be absolutely pure, free and spontaneous. The duty element alloys it. It is a token of moral distinction — the passion of noble and delicate souls; as it loses in extent, it gains in quality, and vice versa. To-day social and political and other interests have almost extinguished it. Especially since the day of romantic love of women, and since modern education has made them the companions of men, friendship in the classical sense is little developed or employed, but it still preserves its moral charm, and is cherished by great, delicate and generous souls. It is still for many the core of their moral life. While it is no longer a cosmic force as in early philosophic systems, and no longer fills a place as large as did love in the ages of the early Christians and chivalry, it is on the verge of a renovation, both in ethics and in modern life.

V.—PHILOSOPHICAL.

Eros und Erkenntniss bei Plato, in ihrer gegenseitigen Förderung und Ergänzung. Von CARL BOETTICHER. Berlin, 1894. Wis. Beiträge fur Jahresbericht des Luisenstädtischen Gymnasium.

Neither M. Koch nor H. Hille has really shaken the Schleirmacher-Zeller idea of Eros as identical with the philosophic impulse. Plato himself probably lived out this idea, but the Eros is also clearly connected with the theory of knowledge. From a study of this doctrine in the Lysis, Phædrus and the Symposium, the author concludes that both Eros and knowledge point to pre-existence and immortality. One seeks the beautiful-good, and the other true existence. These are the same, but the good is supreme and so love is highest. Knowledge is reminiscence, and is determined by the degree of perfection which Eros attains, for the latter is but the impulse to the pre-existent, to get back or return, as some etymologists of religion suggest. It is the bottom lust toward perfection.

Wesen und Entstehung des Gewissens, eine Psychologie der Ethik. Von DR. TH. ELSENHAUS. Leipzig, 1894, pp. 334.

This essay obtained the first prize offered by the theological faculty in Tübingen for the best treatment of the question whether the basal element of ethics is *a priori* or empirical, but it has since been greatly expanded and rewritten and radically changed. The first 160 pages are historical. The last part traces conscience up from biological bases, through organism and animal instinct, and the crude custom of primitive man. But the highest ideal of a completely evolved conscience is found in the Christian ideas of God's kingdom.

Die Psychologie des Unsterblichkeitsglaubens und der Unsterblichkeitsleugnung. Von G. RUNZE. Berlin, 1894, pp. 244.

The author, a Berlin professor, in his series of studies of comparative religious sciences, publishes this volume, which is to be followed by a second part on Immortality and Resurrection, as the first in his series. The idea of immortality originates partly in animism, partly in wish, in dream, in the difficulty of conceiv-

ing death, in the sense of retribution, and is one with the God-idea. Its negation by Mosaism, Buddhism, and Confucianism is discussed. For the general conclusions we are referred to the forthcoming volume. Great stress is laid on the worth of childhood for normal religious psychology and upon the principal *quod volumus credimus*, as even the gods are creatures of our wishes. The feeling that no trace of our earthly life can vanish in all the æons is neither pious nor true. It is not more the *horror nihili* than the impossibility of conceiving annihilation that constitutes the strong negative motive. Psychological considerations warrant no inference concerning the truth or error of an idea so profoundly and irresistibly motivated. This and more underlies all myth, dogma and revelation touching post-mortem existence.

Einleitung in die Philosophie. Von OSWALD KÜLPE, Professor an der Universität, Würzburg. Leipzig, 1895, pp. 276.

Called from Wundt's laboratory to the chair of philosophy, it is natural that Dr. Külpe should interest himself with the introduction to philosophy, and he states that this little volume arose from didactic needs and experiences. The author proposes a "complete orientation concerning the bearing and essence of philosophy," and would describe the "various independent tendencies and achievements in the past and present" with unprejudiced and equal interest, with an evaluation of their value, despite the unavoidable subjectivity and limitations of knowledge. As general disciplines he treats metaphysics, theory of knowledge and logic, and as special disciplines he takes up the philosophy of nature, psychology, ethics and the philosophy of right, æsthetics and philosophy of religion and of history. The tendencies he discusses are singularism and pluralism, materialism, spiritualism, dualism, monism, mechanism, teleology, determinism, and the theological and psychological tendencies in metaphysics. The epistemological directions are rationalism, empiricism, criticism, dogmatism, skepticism, positivism, idealism, realism and phenomenalism. The ethical sections are headed: views on the origin of morals, the morals of feeling and reflection, individualism and universalism, subjectivism and objectivism. The final sections are on the problem and system of philosophy.

Those who have heard Wundt's lectures upon the above philosophical tendencies or read his works will find little that is novel in this book. The revival of the old German idea of a propædeutic or encyclopedia of philosophy was a happy thought, and raises very interesting problems touching the progress of philosophy. Its first suggestion, even in the index, is that in America our professors are in danger of losing the sense of proportion among these disciplines in their teaching. If this is the best introduction, then the methods of inducting the novice through Locke, Berkeley and Hume, or ethics, or elemental logic, ethics or psychology, are wrong. If the object of such an introduction is to develop a bird's-eye knowledge of vast intellectual fields, Dr. Külpe is right, but from his standpoint philosophy is in so far an information study, and its culture power is not much evoked. On the whole one inclines to the view that such preliminary triangulation of vast mental spaces would prove dreary to American students, and that it is too abstract if not too superficial. Possibly a riper scholar in the field, with larger experience in teaching, might bring out greater culture power than Dr. Külpe has done with all his hardihood in attempting an "ology" of all the philosophical isms.

G. S. H.

Friedrich Eduard Beneke, the man and his philosophy. An introductory study. By FRANCIS BURKE BRANDT, PH. D. New York, 1895, pp. 167.

This is an interesting, convenient and careful work, and is No. 4 of the "Columbia College Contributions" to philosophy, psychology and education. The first thirty-seven pages are devoted to Beneke's life and character and the rest to his doctrines, with a final critical estimate, influence and followers. The whole is clearly told, and we are indebted to it for a better view of the system than we have ever had before in English.

VI.—MISCELLANEOUS.

The Psychology of Number and its Applications to Methods of Teaching Arithmetic. By JAMES A. MCLELLEN, Principal of the Ontario School of Pedagogy, Toronto, and JOHN DEWEY, PH. D., Head Professor of Philosophy in the University of Chicago. International Education Series. New York, 1895, pp. 309.

We can think of few subjects in the entire field of psychology that are riper for comprehensive treatment, or the applications of which are more needed in pedagogy, than the psychology of number. Many studies have been made in laboratories on the perception of dots, lines, figures, in the direct and indirect field; many more on counting and the various rhythms involved, the "psychic constant" and its compounds, the psychology of born calculators has been worked out, and the number-systems of primitive people and children's idea of numbers. Other studies are made on number forms, on fatigue in simple operation on numbers, etc. Thus, when we first saw the announcement of this book by an author so capable of gathering up and coördinating these and other lines of work, with the historic material, hardly less interesting, we looked forward with great interest to this book. Dire, however, has been our disappointment. Not one of all these topics is treated with any serious effort at thoroughness, if, indeed, any of them are mentioned. Again, there are many methods of teaching elementary arithmetic, both current and historical, and these should also have been at least mastered by the pedagogic author with a thoroughness of which these pages give no trace. We would suggest for a title of this work, "A Method of Teaching Arithmetic, Explained and Justified, and Preceded by some Philosophic Considerations." We must sympathize with a teacher who, in commenting on it, said in substance that "if the new psychology had nothing better to offer than this, its barrenness will be a great disappointment to hosts of teachers." The first chapter is entitled, "What psychology can do for the teachers," and is surely needed. Number, it is urged, is, first of all, a rational process and not a sense fact. This cuts up all experimental roots at the start, is at best only a partial truth in the author's sense, and is radically and profoundly not only unpedagogic, but antipedagogic. The first *educational summary* is: "The idea of number is not impressed upon the mind by objects, even when these are presented under the most favorable circumstances." Thus nearly every object lesson in arithmetic since Commenius is wrong. The origin of number is derived from the Hegelian ideas of limit. The psychology of quantity is "summed up" in these italicized words: "That which fixes the magnitude or quantity which, in any given case, needs to be measured, is some activity or movement internally continuous, but externally limited. That which increases this whole is some union or partial activity into which the original continuous activity may be broken up (analysis) and which, repeated

a certain number of times, gives the same result (synthesis) as the original continuous activity." The next important summing up is: "(1) The limitation of an energy (or quality) transforms it into quantity, giving it a certain undefined muchness or magnitude, as illustrated by size, bulk, weight, etc.; (2) this indefinite whole of quantity is transformed into definite numerical value through the process of measurement; (3) this measuring takes place through the unit of magnitude by putting them together till they make up an equivalent value," etc., etc. This high cothurnus method of stating with such formal top-loftiness simple and obvious truths till their very inflation makes them seem thin and unreal, does not seem to the writer good metaphysics even, and still less good psychology. G. S. H.

Psychology for Teachers. By C. LLOYD MORGAN, Principal of University College, Bristol. London, 1895, pp. 246.

This book, which is heartily commended in a preface by I. G. Fitch, late inspector of training colleges, first describes states of consciousness, and defines psychology as treating of them. Association, experience, perception, analysis, generalization, description and explanation, mental development, language and thought, literature, character and conduct follow in this order. The book is very simple and elementary, well sprinkled with poetic passages, and with a wholesome ethical application in the last chapter. The question repeatedly recurs whether it is not a little too elementary for teachers, to whom it is addressed, but for its class, it is certainly the best we have in English. Most of its many innovations in subject matter and manner impress us favorably.

Outlines of Psychology, Based upon the Results of Experimental Investigation. By OSWALD KÜLPE, Professor of philosophy in the University of Würzburg; translated from the German by EDWARD BRADFORD TITCHENER, Sage Professor of Psychology in the Cornell University. London, Swan, Sonnenschein & Co.; New York, Macmillan & Co., 1895, pp. 462.

As the JOURNAL has already reviewed the German edition of this treatise, we desire here merely to call attention to this excellent translation. That it is the best treatise in English on *experimental* psychology goes without saying. The translation has rendered to American and English teachers and students of the subject a service that the writer believes they will not be slow to appreciate.

Die Spiele der Thiere. Von KARL GROOS. A. V. Prof. der Philos. in Giesen. Jena, 1896, pp. 359.

The author assumes that animal psychology should have an independent position, and not be regarded as of interest only as it sheds light on the psychology of man, and points of resemblance to man should not receive disproportionate attention. If conversely, we regard what is specifically animal in animals, we shall arrive at a better idea of the animal traits in man. Only a student of æsthetics can properly treat the psychology of play. This is the author's specialty and also his standpoint. Professor Groos rejects the current view of Schiller and Spencer that play is a discharge of superfluous energy; indeed this is not a *conditio sine qua non* of play. The problem centres in the explanation of the play of *young* animals. Certain instincts, essential for the preservation of the species, appear before they are needed. These pre-functional instincts require practice, and fall under the laws of natural selection. Since these inherited instincts can be improved by individual

practice, selections can weaken the blind power of instinct and favor the development of intelligence as a substitute for it. When intelligence becomes strong enough to be more useful than perfect instincts, selection will favor individuals in whom imperfect instincts can be developed by practice during youth, *i. e.*, those that play. Indeed, in a sense, youth is for the sake of play, and animals are young because they must play, and not vice versa. The instinctive underly of the females causes wooing and obstructs the discharge of the sex passion and sublimates it. "Experimenting" plays are primeval, and rest on the pleasure of being a cause. Conscious self-deception is another permanent factor. All animal plays and probably also all human plays, on which another volume is promised, fall under one of the three experimenting, joy or power to do or conscious self-deception, viz., (a) self-presentation, which is personal, and involves animal wooing, and in man the arts of dancing, music and poetry; (b) imitation, which seeks the true and is seen in mimetic arts, sculpture, painting, epic and drama; and (c) ornamentation, which strives for beauty in self-decoration, in architecture, etc.

The book is full of interesting and well sifted and classified facts, but the scheme of classification which is evolved is sure to strike many readers as too artificial to be nothing if not "biological," as the author strives to be. It is of great suggestiveness, and is the first book known to us upon the subject.

The Psychic Development of Young Animals and its Physical Correlation. By WESLEY MILLS, M. A., M. D., F. R. S. C., Prof. of Physiol., McGill University, Montreal. Reprint from the transactions of the Royal Soc. Canada.

The author has for years been studying the psychic and physical development or several animal groups, with a view to compare groups and individuals, and also to connect the physical and psychical growth. This paper is part of this plan, and is a series of careful and almost daily notes on the development of a litter of pure-bred St. Bernard puppies, whelped in the spring of 1894, for the first two months of their lives. These records are full of interesting points, but not adapted for summary or digest.

A Manual for the Study of Insects. By JOHN HENRY COMSTOCK and ANNA BOTSFORD COMSTOCK. Ithaca, N. Y., Comstock Publishing Co., 1895, pp. 701. Net, $3.75.

The senior author is professor of entomology in Cornell and in the Stanford University, and the junior author has engraved most of the 797 wood cuts herself. The work is designed to meet the need for an elementary, systematic text-book for the use of students in high schools and colleges, and of teachers in primary and secondary schools. Perhaps the most distinctive feature is a series of analytical keys, by means of which the family to which any North American insect belongs can be determined. Under the head of each family the characteristics of the family, both as regards structure and habits, are given, and the more common species described. It is thus possible for the student to classify any insect to its family, and to learn the habits of the insects of that family, and, in the case of the more common species, to learn the name of the insect. The book seems to be a work of love, and is by far the best in English, and should be in the hands of every psychologist and every teacher of whatever grade interested in entomology.

NOTES.

We regret that in the editorial in the last number of the JOURNAL the name of Toronto was included in the list of laboratories whose directors had been at some time connected with Johns Hopkins or with Clark University. It was an error which we are glad to rectify here. Those interested in certain other criticisms of that editorial and in the reply to them are referred to *Science*, Nov. 8 and 29.

On page 139 of the last number of the JOURNAL, a person who preferred the spiritual to the true and natural explanation of a form of slate writing trick was spoken of as a "member" of the English Society for Psychical Research. He should have been called an "associate." Thus his name appears in the list at the end of the Proceedings xxvi, Vol. X, Aug., 1894. Mr. F. W. A. Myers desires us to say that his communications have been as an informant and not as a correspondent. Our words were: "prints communications in the English Proceedings," etc.

By inadvertence the initials of the reviewer, G. S. H., were omitted from the notice of "Thinking, Feeling, Doing," by Dr. E. W. Scripture, page 146 of the last number.

NEWS.

The *Gesellschaft für psychologische Forschung* is preparing a volume of short studies as a *Festgruss* to the International Congress of Psychology in Munich.

A psychophysical laboratory has been established in Moscow, under the direction of Professor Tokarski. Twenty students are taking work this year.

With 1896 begins the issue of a new Russian *Journal of Psychiatry, Neuropathology and Experimental Psychology*, edited by Professor Bechterew. It will appear monthly, in parts of five or six signatures.

Dr. Schumann has habilitated as *Privatdozent* at Berlin.

Professor Wundt has published the new edition of his *Logik*, and is now engaged upon anthropological material.

Professor Ribot is not lecturing at the College of France this year. A course in experimental psychology is given by M. Pierre Janet.

Dr. F. Hillebrand, well known by his work in psychological optics, has been appointed extraordinary professor of experimental psychology at Vienna.

The Cornell Laboratory has moved to new quarters, and now occupies a space of 140x45 feet,—a series of nine rooms. A full description will be published elsewhere.

OUR EARLIEST MEMORIES.

M. Victor Henri asks us to publish the following list of questions:

"We possess very few observations on our earliest recollections. I should like to make a series of observations in this subject. I shall be grateful to all persons who will send answers to any or all of the following questions:

1. Age and usual occupation.
2. Do youhave good *visual* representations of objects in general; viz., can you form a visual image of an apple or of a lamp, etc.?
3. Do you have good *auditory* representations (of sounds), viz., have you auditory representations of the voices of your friends?
4. What is the earliest recollection of your childhood? Please describe it as fully as possible. How clear is it, and what was your age when the fact recollected occurred?
5. Had this fact a particular importance in your life, and if so, in what way?
6. Has any one ever related this fact to you, or do you remember it yourself?
7. Can you give any explanation of this recollection, and if so, what?
8. What is the second recollection of your childhood? How far apart are these two in time?
9. Of what period of your life do you first have many recollections without connecting them in the time series of your life? How do they appear; are they clear, are they visual or auditory, etc.?
10. From what period of your life do you begin to have recollections of the time series of your life?
11. Do you ever have recollections of your childhood in your dreams? If so, what?

Please send the answers to these questions to Victor Henri, Leipzig (Germany), Johannis Allée 12. II."

SOME CONSTANT SOURCES OF ERROR IN "RECOLLECTION."

In attempting to answer the above questions, one must pay especial attention to three rules of introspection of memorial contents. (1) Care must be taken that the occurrence remembered is not a *dream* memory. Sometimes a dream memory bears upon its face the marks of its origin; thus one of the writer's earliest and most distinct "memories" is that of flying down a flight of stairs, from nursery to dining-room. Most children play at a "flying game," which consists in standing on a chair and flapping the arms bird-fashion. In the present instance, a vivid dream following upon the playing of the game has persisted as a true "memory." The conviction of the reality of the experience is absolute in the writer's mind; it is logic, and not psychology, which tells him that it could never have happened.—Now, at other times, the logical criterion is difficult or impossible of application; and the memory record has, therefore, very little value, unless corroborated by external evidence. (2) Care must be taken that the memory is the memory of an *experience which was never reduplicated.* Another of the writer's early memories is that of a mantel-shelf, on which stood three vases—two green and white, and one reddish purple. Why the particular set of visual images made so strong an impression on consciousness, he does not know. But here is the point: The memories of mantel-board and purple vase are extremely hazy. These objects ceased to be seen at a very early period of his life. The green and white vases are distinctly remembered; but they were seen, off and on, until about his fifteenth year. Now, how much of the total memory is original, a true child memory; and how much is due to the recurrent suggestions made by the green and white vases? (3) Care must be taken that the memory be a *real memory*, in terms of mental images of the experience, and not a "memory about," that is, a memory evoked by the form of words used to describe that experience. A friend of the writer's remem-

bers accurately a funeral which took place two years before he was born. The description made a deep impression on his childish mind; and he has subsequently reconstructed the experience from the form of words employed to describe it. Here again, there is need of external evidence and control.

The Mueller-Lyer Illusion.

The typical form of this illusion is the following: Two straight lines are drawn, of equal length. The one is bounded by oblique lines which make of it a double-headed arrow, the other by oblique lines which make of it an arrow-shaft, feathered at each end. The latter now looks considerably longer than the former.

An interesting practical illustration of the illusion is given in two recent books upon freehand lettering (H. S. Jacoby, "A Text-book on Plain Lettering;" F. T. Daniels, "A Text-book of Freehand Lettering)." It follows from the illusion, as described above, that the round-topped letters (O, C, S, etc.) will seem shorter than the square-topped (T, E, etc.), if the two sets are objectively of the same height. In looking through some books of printer's alphabets, the writer has found that this fact is not seldom allowed for: a lineal, laid over the alphabet squarely with the tops of the square letters, lets the tops of the round letters appear above it. But as many alphabets make no allowance for the illusion, it would seem that the rule of difference is not explicity recognised by type-cutters.

Mr. Daniels calls attention to the psychological factors in the illusion (p. 10), and illustrates them very forcibly in Plate 3. Professor Jacoby also enters into the reasons which make it necessary to increase the height of the curved letters (pp. 4, 8, etc.), and illustrates in several plates.

Thought Transference.

The judgment passed upon the methods of the "psychical research" societies, in the previous number of the Journal, is fully borne out by experiments upon thought transference, published by Drs. Hansen and Lehmann in the current number of Wundt's *Philosophische Studien*. The authors set to work in grim scientific earnest, with an arrangement of concave mirrors, to discover whether transference of visual thought pictures was effected by any new mode of energy, "radiation," or what not. It was found that they were not transferred at all. What happened was that the transmitter involuntarily whispered the name of the impression to be transmitted, and that the percipient heard the whisper. An elaborate study is made of the carrying power of the whisper, of its phonetics under different conditions of production, of the confusions to which it is liable—as distinct from the confusions possible with spoken words, of its voluntary suppression, etc.; and the results of Professor Sidgwick's "experiments" are subjected to a searching analysis in the light of the new source of error.

The investigation is a model of methodical work,—of work carried on in the spirit of impartial scepticism, which is characteristic of the scientific method in general.

Errata in the Translation of Kuelpe's Psychology.

By the courtesy of my fellow editors I am enabled to give here what I believe to be a complete list of the *errata* in my translation of Professor Kuelpe's *Grundriss der Psychologie*. I have apologised

to purchasers of the work as best I could, by having a slip printed in which attention is called to the principal errors. The printing of the translation overseas made it impossible for me to undertake more than a single revision.

Page	4	line	38	for	*differences*,	read	*differences*
"	17	"	27	"	ascocia-	"	associa-
"	35	"	15	"	latter	"	later
"	44	"	7	"	conclusoins	"	conclusions
"	61	"	36	"	It	"	it
"	70	"	21	"	*r*—	"	1—
"	73	"	4	"	it	"	is
"	105	"	28	"	40,000	"	4,000
"	108	"	2	"	fields	"	Icelandic fields
"	136	"	16	"	quadragemina	"	quadrigemina
"	166	"	25	"	equal,	"	equal
"	190	"	35	"	perhaps	"	perhaps,
"	197	"	9	"	results	"	result
"	207	"	7	"	hearing,	"	hearing.
"	208	"	30	"	depends	"	depend
"	233	"	38	"	underlying,	"	underlying
"	242	"	20	"	character	"	character.
"	250	"	16	"	(c.)	"	(c)
"	268	"	11	"	, ;	"	; ,
"	276	"	2	"	insolated	"	isolated
"	276	"	18	"	may	"	may,
"	280	"	15	"	character	"	the character
"	294	"	32	"	seventh)	"	seventh),
"	295	"	22	"	overtones	"	partial tones
"	297	"	14	"	overtones	"	partial tones
"	297	"	21, 23	"	overtone	"	partial tone
"	311	"	1	"	equational	"	equatorial
"	311	"	2	"	colours	"	colour
"	317	"	42	"	reylal	"	really
"	322	"	29	"	III),	"	III.)
"	325	"	30	"	simular	"	similar
"	343	"	12	"	, rule	"	rule,
"	375	"	38	"	of the	"	the
"	387	"	15	"	of pairs of	"	of
"	387	"	16	"	two impressions	"	two pairs of impressions
"	421	"	42	"	elary	"	early
"	462	"	5	"	120	"	61, 120
"	462	"	36	"	Wegner	"	Wagner

E. B. TITCHENER.

MEETING OF THE PSYCHOLOGICAL ASSOCIATION.

The fourth annual meeting of the American Psychological Association was held at the University of Pennsylvania on Dec. 27 and 28, the time and place having been chosen to coincide with the meetings of several other more or less closely related societies, to wit: the Geological Society, the Physiological Society, the Association of Anatomists, the Society of Naturalists and the Morphologi-

cal Society. The opportunity thus afforded of meeting and hearing distinguished workers in other lines added much to the interest of the psychological programme. It is needless to add that the visitors were most hospitably entertained by the Local Committee of Reception.

The programme was as follows: Friday morning: Psychology and Physiology, Professor George S. Fullerton; Description of a Series of Physical and Mental Tests on the Students of Columbia College, Dr. Livingston Farrand; Some Psycho-Neural Data, Dr. Arthur MacDonald; An Experimental Investigation of the Processes of Ideation, Mr. Oliver Cornman (introduced by Professor Lightner Witmer). Friday afternoon: Address of the President, Professor J. McKeen Cattell; Direct Control of the Retinal Field (an informal communication), Professor George T. Ladd; Consciousness and Time, Professor Charles A. Strong; Some Conditions of Will Development, Brother Chrysostom. Saturday morning: Discussion on Consciousness and Evolution, Professors William James, E. D. Cope, J. Mark Baldwin, Charles S. Minot, George T. Ladd, and others. Saturday afternoon: An Experiment on the Effects of Loss of Sleep, Professor G. T. W. Patrick; Further Researches on the Psychic Development of Young Animals and its Physical Correlation, Professor Wesley Mills; Variations in the Patellar Reflex as an Aid in Mental Analysis, Professor Lightner Witmer; Experiments on Induced Hallucinations, Professor James H. Hyslop; Cases of Dream Reasoning, Professor W. Romaine Newbold.

In the business session of the Association the following officers were elected: President, Prof. G. S. Fullerton, of the University of Pennsylvania; Secretary and Treasurer, Dr. Livingston Farrand, of Columbia College; Members of the Council, Professors Edward H. Griffin of Johns Hopkins and Edmund C. Sanford of Clark. On nomination by the council, the following new members were also elected: Prof. E. D. Cope, University of Pennsylvania; Prof. C. S. Minot, Harvard Medical School; Mr. J. E. Low, Harvard Psychological Laboratory; Mr. E. A. Singer, Harvard Psychological Laboratory; Dr. N. Wild, Columbia College; Dr. C. H. Bliss, University of the City of New York; Dr. Franz Boas, American Museum of Natural History, New York; Mr. Warner Fite, Williams College; Dr. J. E. Creighton, Cornell University; Dr. H. Austin Aikins, Western Reserve University; Dr. W. G. Smith, Smith College.

On motion of Prof. Baldwin of Princeton it was voted that a committee of five be appointed to consider the advisability of formulating a plan for a set of systematic physical and mental tests to be undertaken jointly by various psychological laboratories interested, and to report on the same at the next meeting of the Association. The committee as appointed is as follows: Profs. Baldwin, Jastrow, Sanford, Witmer and Cattell.

The formation of a Philosophical Society, or, more exactly, the partition of the Association into two coördinate sections, one devoted strictly to psychology, the other to philosophy, was discussed informally, and by vote of the Association referred to the Council with the request that they canvass the matter and report at the next meeting.

It was also voted that any members attending the International Psychological Congress in 1896 should receive authorization to act as delegates of the Association on communication with the secretary, Dr. Farrand.

The time and place of the next annual meeting were left for the decision of the President of the Association.

Books Received.

Aars. Untersuchungen über Farbeninduktion. Pp. 15, 3 charts. Kristiania, 1895.

Allin. Ueber das Grundprincip der Association (Inaug. Dis.). Pp. 81. Berlin, 1895. Mayer and Müller. Reviewed in this number.

Beaunis and Binet. L'Année Psychologique. Alcan, Paris, 1895. Price 10 f.

Chaslin. La confusion mentale primitive, stupidité, démence aigue, stupeur primitive. Pp. ix-264. Paris, Asselin et Houzeau, 1895. Reviewed in this number.

Comstock. Manual of Insects. Pp. 701. Comstock Pub. Co., Ithaca, 1895. Price $3.75. Reviewed in this number.

Donaldson. Growth of the Brain. Contemporary Science Series, Scribner's Sons importers. Price $1.25.

Fouillée. Tempérament et caractère selon les individus, les sexes et les races. Pp. 378. F. Alcan, Paris, 1895. Reviewed in this number.

Fraser. Philosophy of Theism. Being the Gifford Lectures Delivered before the Univ. of Edinburgh in 1894-95. First Series, 1895, pp. 303. Imported by Chas. Scribner's Sons. Price $2.00.

Groos. Die Spiele der Thiere. Pp. xvi-359. Gustav Fischer, Jena, 1896. Price 6 m. Reviewed in this number.

Heinrich. Die moderne physiologische Psychologie in Deutschland. Pp. 235. E. Speidel, Zurich, 1895. Price 4 m.

Jerusalem. Urtheilsfunction. Braumüller, Wien, 1895.

Kuelpe. Outlines of Psychology. Based upon the results of experimental investigation. Translated from the German (1893) by Edw. B. Titchener. Pp. 462. Macmillan & Co., 1895. Price $2.60. Notice in this number.

Lefèvre. Obligation morale et idéalisme. Pp. 157. F. Alcan, Paris, 1894.

Le Maitre. Contribution a l'étude des états cataleptiques dans les maladies mentales. Pp. 96. G. Steinheil, Paris, 1895. Reviewed in this number.

Roark. Psychology in Education. American Book Co., New York, 1895. Price $1.00.

Schwarz. Die Umwälzung der Wahrnehmungshypothesen durch die mechanischen Methode. Nebst einem beitrag über die Grenzen der Physiologischen Psychologie. Pp. 213. Duncker & Humblot, Leipzig, 1895. Price 9 m. Reviewed in this number.

Stanley. Studies in the Evolutionary Psychology of Feeling. Pp. 392. Macmillan, 1895. Price $2.25. Reviewed in this number.

Watson. Hedonistic Theories from Aristippus to Spencer. Pp. 248. Macmillan & Co., New York. Price $1.75.

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A STUDY IN THE PSYCHOLOGY OF RELIGIOUS PHENOMENA.

BY JAMES H. LEUBA,
Fellow in Psychology, Clark University.

INTRODUCTION.

The passage from the standpoint of knowledge for knowledge's sake, to that of knowledge for life's sake, expresses one of the aspects of the widest movement of modern intellectual evolution. Our age, and in particular the Anglo-Saxon race, has gained the reputation of being intensely practical. This tendency has a deeper philosophical meaning than is generally recognized. As the child passes with advancing years from actions having no objective end to activities for definite results, in a like manner do nations turn from the delusive grandeur of the knowledge for knowledge's sake ideal to that of knowledge for life's sake, and substitute the Gospel of Being and of Doing for that of Knowing.

Intellectual pursuits have been powerfully stimulated and their direction much altered by this great life-wave. Until the beginning of our century the formal operations of the mind and the framing of cosmological schemes were the chief objects of philosophical meditation. Schopenhauer, following in the steps of some predecessors, and reacting against what we like to call static philosophy, brought us face to face with the unconscious, the emotional, the striving forces of nature. Up to him philosophy was anatomical; he made it physiological.

It is in psychology that we find this "practical"

tendency working the most decisive changes. With the increased interest in the impulsive, the instinctive, the affective side of life in general, a number of new lines of research, all having a close relation to life, have been opened: Child study, the psychology of growth, of adolescence, of sex; some branches of anthropology, psychiatry. And instead of standing aloof from life on barren heights, modern psychology feeds on biology and on physiology, and is the handmaid of pedagogy and of ethics.

There remains a domain in which psychological science has not yet planted its standard: it has ignored the manifestations of religious life. Yet there are few questions engrossing so much the attention of our thinking world as that of religion, and there are no spheres in which more powerful creative forces are at work.[1] The fall of Christian orthodoxy is accompanied with a recrudescence of religious fervor. Neo-Christian movements are in progress in France[2] and in Germany, and have long since begun to agitate England and the United States. All over the civilized world men's hearts and brains are in travail with a new Revelation.

It is true that a great deal of historical and philosophical work bearing on the religious problem has been done during the past decades, but no researches, from the standpoint of modern psychology, on the subjective phenomena of religious life have appeared. Comparative studies of religions, historical accounts of their growth and development, investigations into the contents of the religious consciousness, are valuable contributions to our knowledge. They accomplish for religion what would have been done for medicine, before dissection was practiced, by historical researches, comparative expositions of the various notions and systems in vogue in different countries, and the like; all of which is very good and useful; but the essential work, the scientific work *par excellence*, that was to give to medicine a solid foundation, was the actual study of the body by means of scalpel and microscope.

If religion has any reality, it must perforce express itself in pyschic and physiological phenomena. The work of a true Science of Religion, as we understand it, is to find out what these subjective manifestations are, and then to treat them as it would any other psychic fact. Neither the theories, nor the external practices, rites or ceremonies, but the deeper

[1] Consider the amount of life poured into the veins of humanity by such men as Gautama, Jesus, St. Augustine, St. Francis of Assisi, Luther, Wesley, Booth, and others.

[2] For an account of the Neo-Christian Movement in France, see the AM. JOUR. PSYCH., Vol. V, pp. 496 ff.

subjective realities experienced by the individual, constitute the material out of which the New Revelation will issue. Never mind the old and the new popular beliefs concerning these realities, never mind the body of doctrines held by the subject of these experiences; *mind the subjective fact in itself.* To it science must apply its tools, for it is the essence of religious life. After all, the questions which must be solved are the following: *What are the gifts in the hands of Religion, and how can man become partaker of them? How and by what in religion is life transformed and ennobled? How is man "born again"?* These are the questions confronting Science and Philanthropy alike.

We would not convey the impression that we hold in contempt the labors of the eminent workers in the field of the history and philosophy of Religion. We would only direct the attention of those interested in this problem to another line of research, and emphasize our conviction—which, we cannot help thinking, will be shared by all those who have learned the lesson given us by the history of the Natural Sciences,—that its solution will come only from the scientific psychological study of every one of the particular subjective manifestations of religious life.

Supposing that these several phenomena have been singled out, and that, as far as our means permit, they have been determined in their cause and in their nature, we should possess in these theoretical results the elements of a science of religion. The new creed would be born; the wings of youth would no more be clipped in the spring of life by a scholastic dogmatism; and the soul-midwifery now extensively, but ignorantly, practiced by our revivalists and pastors, could be based upon a positive knowledge of the psychology of regeneration. "What a fantastic dream!" many will exclaim. It must be admitted that the difficulties in the way of such a task are serious, and that we are as yet far distant from the goal; nevertheless, that it is no Utopia, but the sure conquest of a near future, is warranted by the recent advances of psychology; for, wherein do religious phenomena essentially differ from some of those with which that science is now dealing? The religious experiences named *sense of sin, repentance, remorse, aspirations toward holiness, regeneration (conversion), trust, faith,* belong to the same class as the affective problems now under study, as, for instance, the question of pain and pleasure, the relation of the feelings to the intellect, the motor power of ideas, attention, effort, etc. If they do not include the whole of religious life, the facts we have mentioned constitute at least the essence of Christian life; for what reason should we pry into the latter

and refrain from inquiring into the former? The subjective facts of religious life belong to psychology. It is the duty and the privilege of that science to extend its beneficial sceptre over this realm also. The time is particularly favorable for such an annexation; the power that ruled during the past centuries has grown senile, its authority is denied; a painful anarchy prevails. Let psychology accept the succession that falls to it by right.

Led by considerations, some of which are indicated in the preceding pages, while others are to be mentioned in the following section, we have undertaken a study of the phenomenon commonly called "Conversion." We have chosen conversion because of its striking and well delineated characteristics, and on account of its paramount importance in religious life. Moreover, material for the study could be collected without too much difficulty. The reader may feel that our choice has been presumptuous. However that may be, it is with a painful feeling of its incompleteness and insufficiency that we send forth the following essay. Had it no other value, it would at least be an indication of what might be done in this department of psychology.

As a number of records of conversions has been appended, we shall dispense with a description of the experience going under that name.

We have limited our material to sudden and well marked cases, for the reason that violent psychic phenomena, by their very emphasis, bring to light what remains obscure in less intense and slower events. In the main the conclusions reached by the study of sudden conversions apply with equal exactitude to slowly progressing regenerations.

The Religious Motive.

We are aware that many will be of the opinion that the subject of our inquiry is an abnormal phenomenon, which would not occur in a healthy and enlightened community; they will see in it mere idiosyncrasies extraneous to the main current of life. That such an estimate ignores the true nature of conversion will be made apparent, we hope, by the following rapid glance at the evolution of religious consciousness.

Religious philosophers have experienced perplexing difficulties when they have attempted to extract from the various known forms of religion, common characteristics which could serve in the making of a definition of Religion. Herbert Spencer finds the vital element of Religion in the impulse of the human race to seek for first principles:—

Religions diametrically opposed in their overt dogmas, are yet perfectly at one in the tacit conviction that the existence of the world with all it contains and all which surrounds it, is a mystery ever pressing for interpretation. On this point, if on no other, there is entire unanimity. . . . . That this is the vital element in all religions is further proved by the fact that it is the element which not only survives every change, but grows more distinct the more highly the religion is developed.

No definition considering religion as a noetic impulse and making it dependent upon particular conceptions, as that of God, of soul, of spirit, of immortality, can possibly be adequate. *The essence of religion is a striving towards being, not towards knowing.* If Spencer, and the many philosophers who think with him, were right, religion, purified of superstitions, would be neither more nor less than philosophy and science, and the natural culmination of the various forms of religion could only be, as Auguste Comte affirmed, Positive Philosophy, following upon Metaphysics, itself the child of Religion.

That which the term Religion embraced in early societies was a complex product, made up of all the fundamental needs and aspirations of men. It was an embryo containing potentially several different parts and functions as yet undifferentiated, and consequently going under a common name. Thinkers of the opinion quoted above have followed the development of one limb—of the head, if you please—and ignore whatever else grew out of the embryo. The noetic impulse was one of the elements contained in the primitive conglomerate, to be sure; but not the only one, perhaps not even the chief one. Auguste Comte's three stages correspond truly to three links in the chain of evolution, but he failed to see that at every link other links branched off. Positive philosophy is the form assumed *in our time* by one of the germinating elements contained in the primitive plasma known originally as Religion; the thirst for knowledge. But something else issued forth from primitive Religion—a something essentially different from a propensity to solve the riddle of the universe. It is this other shoot which is to-day the vital force of that which has inherited the name of religion. In the remainder of this chapter we shall try to point out the nature of that motive power. It is not yet completely differentiated from the philosophical motive; they are still blended together in practice and in theory. However, theologies and philosophies are being rapidly winnowed out by the blind intelligence of growth, and religion will soon have assumed an independent and definite figure clearly separated from the latter.

The religion of the savage, roughly described, includes

beliefs in spirits, good and bad, endowed with the power of harming and prospering. It finds expression in emotions of fear and of hope, of anger and of good will; in rites and ceremonies destined to please the spirits, with the expectation of direct returns, or prompted only by a desire for fellowship. Let beliefs in spirits cease, and this form of religion is at an end. When the relation between man and the Powers above assume a higher aspect, we rise to the Jewish and Christian religions, for instance. Fear, which plays such a preponderant rôle in primitive religions, as also in the childhood of the individual, is replaced by love. God is now pictured as a sympathetic Father, listening and answering, never angered against His truly repentant children. He stands at the door of the paternal mansion with outstretched arms to receive the prodigal son. If the belief in a beneficent personal divinity watching over the actions of men, able and ready to answer prayers directly, is lost, this form of religion also ceases to exist. Yet religion need not be impaired. History has preserved a famous example of the independence of religious experience from those intellectual concepts. Buddha Sakyamuni was a godless man, in the narrow meaning given to the term God in Christian theology. He discouraged formal prayer, for it ascended but to strike against the adamantine vault of causal connection and to come back in a mocking echo. Yet we recognize in him a remarkably powerful and elevated religious nature. What shall we say of the intellectual vanguard of our day? What is the religion of the few bred in the atmosphere of intellectual freedom and scientific thought, whose strong faith in nature boldly discards the ragged garments inherited from the past? Such men, we venture to say, disavow any fear referring to possible action of the divine power; they have no belief in an interfering Providence, and consequently none in prayer; responsibility they feel towards none but themselves and those affected by their doings; immortality of the "Ego" they, possibly, cannot even hope for; adoration, worship, devotion, piety, in the common acceptation, are incompatible with these negations; outwardly they have no cult, return no thanks, and ask for nothing from the Powers of the world, for they know them to be deaf to such supplications and insensible to human thankfulness; narrowly construed, these words have become dead letter to them. Have these men passed beyond the religious stage? Yes, if religion consists in the intellectual beliefs they discard.

If we have in this essay insisted upon the absolute divorce which must be recognized between intellectual beliefs and

religion, it is because in the rupture of this mischievous identification lies one of the most pregnant practical conclusions which modern life can derive from psychological investigations in religious life. The most evanescent aspects of religion are precisely its intellectual formulations, including the idea of the soul, of the future life, of God, etc.; and the most exalted religious consciousness is consistent with the negative intellectual creed sketched above.

These common conceptions—generally regarded as essential —*rejected or ignored, the religious sense remains*, modified perhaps but unweakened, *in the feeling of unwholeness, of moral imperfection, of sin*, to use the technical word, *accompanied by the yearning after the peace of unity*. No intellectual conviction can rob man of this subjective treasure. Its reality transcends all possible belief concerning the origin and the end of things, because, as we hope to show, it is the psychic correspondent of a physiological growth, and consequently can in no wise fail, except together with that growth. Around this religious root, springing from it, or otherwise functionally related with it, cluster all the familiar religious feelings. For instance, altruistic love is implied in the efforts to attain unity of moral consciousness, for we learn in such experiences that the "sacrifice of self" gives ease to the pain of sin; the failure of one's efforts to attain moral perfection develops the sense of dependence, of subjection, which has of late been made the centre of many definitions of religion. He who has these feelings — which are rooted in the sense of sinfulness — possesses the efficient essence of religion.

Herbert Spencer's opinion quoted above, as well as al theories making religion depend upon the *desire to know*, instead of upon the *desire to be*, are belied by the biographies of the great founders or promotors of religions. They were not, as we shall presently see, preëminently preoccupied by the riddle of the objective universe. On the contrary they often ignored almost completely the philosophical problems referred to by the author of the Synthetic Philosophy. *Their concern is the attainment of moral perfection, of inward unity;* their speculative interest — as far as it exists — is the result of the activity of the ratiocinating wheels put in motion by the moral needs.

The life of Gautama, however lacking in historical certitude, leaves no doubt that what launched him into his religious career was not the goading riddle of the universe, but the deep moral struggle from which he suffered. After the Great Renunciation under the Bow tree and his victorious encounter with temptations, he declared, "I am now going to the city of Benares to establish the kingdom of righteousness,

to give light to those enshrouded in darkness, and open the gates of immortality to men. I have completely conquered all evil passions, and am no longer tied to material existence, and I, now, only live to be the prophet of perfect truth." The end he has sought—to conquer all evil passions—is now attained; henceforth he can consecrate himself to his fellow-men and live to show them the way of salvation, which he conceived as absorption in the Great Cosmic-All, made possible by triumph over every evil tendency. Much less than his predecessors did he concern himself about metaphysical queries. His disciples, it is true, obscured the practical end he had in view and the practical means devised to attain it, by developing a system of metaphysical doctrines; the same happened to Christ. The Masters were content with dealing in experiential realities; the disciples fed upon theories and abstractions. For Gautama salvation is a practical psychological reality: it is *deliverance from suffering;* from the *moral* suffering due to the thirst leading from birth to birth; thirst for pleasures, for becoming, for power. It is nearly synonymous with Schopenhauer's "will to live," and also with the Christian conception of the desires of the "Natural Man," or rather we should say that these various ideas are the outcome of the same experience: of the consciousness that the deepest cause of our suffering is lodged in warring desires, and the perception that the selfish will must be destroyed before happiness can be enjoyed. The life of Gautama expresses powerfully this truth.

Pfleiderer, in his "Philosophy of Religion," Vol. III, p.65, in commenting on the spirit of Buddhism, has the following remarkable passage:

> Nowhere is the elimination of metaphysics from religion (which is so much demanded in our days) in favor of a purely ethical and psychological way of looking at things, carried out to such a degree as in Buddhism; but just on this account it proved a religion without God and without soul, a religion in which religious mystery is contracted to a mere vanishing shadow of a possible outer world, a religion, therefore, which completely lacks motive power both for progressive and deepening knowledge, and for world-conquering action. For only out of the depths of the divine mystery do the never-ceasing streams of living spiritual power issue forth; the streams which spring from the mere surface of experience do not flow to life eternal.

We quote these words to make clearer by contrast the view we are trying to make good in this part of our essay, *i. e.*, that the essence of Religion in its modern form, in contradistinction to Philosophy and Metaphysics, is properly the more or less clear consciousness of what Pfleiderer is pleased to call "the mere surface of experience," and that the power

of religion is proportional to the depth and intensity of the feelings connected with that experience. The lives of Jesus and of Buddha give a flat denial to the distinguished author of the "Philosophy of Religion." The "divine mystery" is not the craving for metaphysical knowledge, it is the universal and unquenchable thirst for wholeness, for moral harmony. We shall have occasion to observe in the chapter on self-surrender that the only apparent motive power in the deepest religious experiences is the feeling of unrighteousness and the effort towards holiness. It is only when "Salvation" was secured that St. Augustine sought for the how and the why, and elaborated out of what passed in himself the theories concerning total depravity and election. His religious beliefs were the product of ratiocination on his experience of conversion, and not the cause of it. The comparative inferiority of Buddhism to Christianity is not due to its metaphysical bareness, but to the greater weakness of the moral promptings of the Hindoo race.

The advent of Christ marks a step further in the growth of the dual moral consciousness. Psychologically his influence could be defined on one hand as bringing about a deeper and consequently a more painful differentiation of motives, a deeper cleavage of consciousness, into warring parts, and, on the other, as leading and helping men to a solution of the dualism. We know not through what crisis Christ may have passed previous to his appearing on the scene of the world. Indications of a possible moral turmoil of the same nature as that of Gautama and of other great religious leaders, are nevertheless not entirely lacking in the life of Jesus. His baptism by John in the Jordan and the temptation of forty days in the wilderness, following hard upon the baptism of repentance, according to the gospel narration, lend themselves easily to such an interpretation. Perhaps his affirmation to Nicodemus, who does not understand how a man can be born again of the Spirit, "Verily, verily, I say unto thee, we speak that we do know, and bear witness of that we have seen" (John iii:11), should be construed as a reference to his own "new birth." At any rate, when he begins his career, he possesses the serene unity for which the founder of Buddhism had had to struggle for years. Christ expresses his inner condition in august words like these: "I and the Father are one." This and like utterances are but the objective formulations of his moral unity, of his sinlessness. His central desire now is to bring men to the Father, that they also may be one with Him. Sin has estranged man from the Holy God, hence reconciliation and

the establishment of relations of perfect love with the Father presuppose the voluntary abandonment of all wickedness. This sin is regarded as the source of man's misery, *and the goal of religious life becomes regeneration, by which unification of motives,—i. e., union with God, when objectively considered—is achieved.*

Christ refrained from formulating elaborate doctrines of salvation, he remained close to the empirical facts of regeneration. From practical and empirical, his disciples have made religion speculative and theoretical. Although we have had as yet neither the good sense nor the courage to return to plain religious empiricism, the first steps in that direction have been taken. The later creeds of Christendom show a well-marked tendency to revert to the simple formulation of the contents of the religious consciousness, and dwell with less and less weight on the metaphysical interpretations given to them by the early church. It is a fact of common observation that our pulpits have almost completely forgotten those articles of the creed which formerly attracted chief attention, and that they are absorbed in preaching regeneration and sanctification. To be religious is no more to conjure and sacrifice, no more to adore, no more to believe in dogmas; it is to live righteously an altruistic life. A conversion unifying the newly born energies of the soul is coming to be the immediate and exclusive end of Christian preaching. And if salvation is still pictured under the form of an objective reconciliation, of a readjustment of relation between man and God, it is nevertheless affirmed with increasing emphasis that subjective renovation is its essential condition. That the need and the means of regeneration are the motor powers of Christianity, is a truism. Christ made the new birth the centre of His teaching; Paul experienced and preached it. In the first days of Christianity sudden conversions seem to have been the rule, and subjective regeneration continued to be the condition of entrance into the church until formalism displaced, more or less completely, living faith. Then baptism became, for long dark centuries, not only the symbol, but also the substitute for regeneration. Yet the word Regeneration was kept, and the church persistently and illogically affirmed that without it—or its symbol—there was no possible salvation. A side current, however, preserved the living doctrine. It is manifest in the ascetic spirit of the saints of the Middle Ages; the experience of many of them reads like the conversions of the revivals of the eighteenth and nineteenth centuries. Most if not all of the religious reformers of the Renaissance, as also the instigators of the great religious move-

ments of the last century—Assisi, Loyola, Luther, Fox, the Wesleys, Whitefield, Edwards, may be instanced—received their life-impulse from a conversion experience, which they embodied in the famous motto, "Salvation by faith." Religious reformations in the Christian church have always been, at bottom, returns to the fact of deliverance from sin (what we have termed unification of motives) through faith, *i. e.*, a return to the biological teachings of Christ and of Buddha concerning the new birth.

We know the dominant rôle which this motive plays in our modern orthodox churches, particularly in the United States.[1]

It is less known that outside the pale of orthodoxy, in those confessions of faith which had, in their poverty of religious

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[1] The following facts concerning the influence of Revivals may be of interest to our readers:

The Rev. Mr. Albert Barnes in his sermons on Revivals, New York, 1841, says: " . . . . they [Revivals] have done more than any other single cause to form the public mind in this country." "Society has received some of its most decided directions from these deep and far pervading revolutions." P. 20.

We find in the memoirs of the Rev. A. Nettleton, the famous Revivalist, edited by B. Tyler: "During a period of four or five years, commencing with 1798, not less than 150 churches in New England were favored with special effusion of the Holy Spirit; and thousands of souls, in the judgment of charity, were translated from the kingdom of Satan into the kingdom of God's dear Son." P. 13 of 5th ed.

In 1829 a circular was sent to the pastors of Congregational churches in Connecticut, with questions on the usefulness of Revivals. "It appeared [from the returns] that a large proportion of all who are now members of the Congregational churches in this state became such in consequence of Revivals; . . . . . that the most active and devoted Christians are among those who came into the church as fruits of Revivals, ..."

Very interesting information regarding the opinion of the foremost "educational" men of the time on Revivals and conversions, can be gathered from the Appendix to Dr. Sprague's "Lectures on Revivals of Religion," 2d ed., 1833. The book itself is meant to be a text-book for Revivalists, or professional convert-makers. The Appendix is composed of letters from ten or more college presidents, including Yale, Brown University, Princeton, Amherst, Williams; and from prominent divines, as the Rev. Noah Porter, the Rev. Archibald Alexander, the Rt. Rev. Ch. M'Ilvaine, Bishop of Ohio. These gentlemen relate the Revivals they have witnessed, and express their convictions concerning their nature, and the most effective methods of conducting them. They are all, in various degrees, in sympathy with Revivals. Better than anything else to estimate the rôle played by conversion in giving direction to individual and national life in this country, are the chapters on religious life in the histories of colleges, such as Amherst, Yale, Williams, where conversion was looked upon as the normal culmination of Christian education.

sense and abundance of intellectualism, more or less dropped the corn with the husk, and whose resulting deadness had become a popular argument against their negations, a revival of the religious spirit is in process. It manifests itself in a new interest in Regeneration and in a growing sense of its meaning and necessity. The book of Edmund H. Sears on "Conversion," and especially the two essays entitled "Regeneration," one by the Rev. Thomas R. Slicer, the other by Francis C. Lowell, read before the National Conference of the Unitarian churches, held at Saratoga Springs, N. Y., Sept., 1894, are characteristic tokens of the movement we signal. The doctrinal setting is greatly changed, it is evident, but the fact itself is acknowledged as the distinguishing mark of the true Christian. "What we are concerned to know is this: Does the new birth of which I have spoken give an entrance here and now into the kingdom of heaven which can be won by no other road? I think it does. Though it seems a paradox, I believe that no one can fully know himself a child of God until he comes to realize how deeply he has sinned. . . . Such an experience, then, it seems to me, is to be desired by every man; that is to say, it is typical of the best, the most nearly perfect religious experience," said Mr. Lowell in the address mentioned. The Rev. Thomas Slicer's essay is in the same spirit, and contains nothing that suggests disagreement with the above quoted opinion.

We can profitably bring the preceding passage side by side with the following from the great Trinitarian, Jonathan Edwards:

"I am bold to say that the work of God in the conversion of one soul, considered together with the source, foundation and purchase of it, and also the benefit, end and eternal issue of it, is a more glorious work of God than the creation of the whole material universe."[1]

Unitarians and Calvinists agree on the question of experience, on the essence of religious life; they disagree on the theory, on the metaphysics of conversion. When the division between metaphysics and science has been fully recognized in Religion, the church will take cognizance of facts only, and leave to independent specialists the post-experiential speculations.

To sum up, religious consciousness has been gradually clearing itself from the philosophical motive with which it has been associated from the beginning. The religion of primitive man born of a sense of *physical* dependence, gradually yields, as the sense of sin is realized, to ethical re-

[1] In his "Thoughts on the Revival of Religion."

ligions, in which man is actuated by a sense of *moral* dependence, or, to state the same fact in other words, by a feeling of sinfulness, of moral imperfection and weakness; he exclaims with Paul: "For what I would, that do I not; but what I hate, that do I." This feeling is the religious motive as felt at our stage of development. *Religion has become — or is coming to be — the conglomerate of desires and emotions springing from the sense of sin and its release.* Silently along with the struggle for existence of individual against individual, another one, purely subjective, often eclipsing the former by its grim relentlessness and tragic seriousness, turns the heart of man at all times into a duelling ground, and some times into a hellish tempest. Those who escape least the torments of this dualism, are, it seems, the best. The fastidious conscience, as also the callous, proverbially honest man, find rising from the very centre of their being unquenchable yearnings for the attainment of a moral unity which will bring with it the deep peace and joy of which glimpses are obtained in spite of the thousand little compromises in which we wallow. The philosopher pants for what he terms the realization of himself; the Hindoo falls in ecstasy before the vision of an abode of rest from the hard conflicts of this sensuous life; the Christian prays for deliverance from sin, pardon, purification and holiness. The reduction of the dualism thus variously expressed is, in the broadest sense, what we mean by conversion.

Anticipating conclusions to be reached in the third part of the essay, we may say that moral dualisms and their reductions are the psychic correlates of the establishment of new physiological functions. Conversion might be defined in the favorite terms of Herbert Spencer, as the unification, by coördination, of the parts segregated by differentiation of the homogeneous. Instead of being an abnormal process, conversion—not necessarily the violent type which we have chosen for our analysis—is the very creating method of nature. It represents a physiological as well as a psychic step in the evolution of man.

Prejudices and ignorance have had free scope to discredit the value of the class of experiences herein dealt with. That a considerable number of reported conversions were only temporary stimulation to better living, and that some of them were mere pretence, is evident.

Concerning the permanency of conversions, the following quotations may be of interest:—The Rev. Chas. Hyde, pastor of a church in Ashford, wrote May, 1844: "His influence [A. Nettleton's] was permanently good." Concerning the eighty-two converts who were the fruit of Nettleton's activity in the parish, he writes, "Of

the character of these converts, I cannot speak particularly, except of those who are now here. Twenty-two have died, twenty-seven have removed from the place, three only have been excommunicated. The remainder are, with hardly an exception, now consistent members,—some of them pillars in the church."—"Memoirs of Rev. A. Nettleton," p. 89, 5th ed.

In 1832, eleven years after the Revival mentioned in the following quotation, the Rev. Dr. Porter declares: "Within about three months, I suppose there were about 250 members who supposed they had passed from death unto life. On the first Sabbath in June, 115 were added to the church, and at subsequent periods 120 besides. Of these a few have since been rejected, and others have declined from their first love. But I have not perceived that a greater proportion of hopeful conversions in this Revival than in others, previous and subsequent to it, have proved unsound. Many have died, and many have removed from our immediate connection, but those who remain, now constitute the chief strength of the church."—From Appendix to Dr. Sprague's "Lectures on Revivals of Religion," 2d ed., 1833.

In "The Testimony and Advice of an Assembly of Pastors of Churches in New England at a Meeting in Boston July 7, 1743," signed by sixty-eight ministers and otherwise endorsed by forty-three others (ninety of them were from the Province of Massachusetts Bay), we read: "Yet of those who were judged hopefully converted and made a public profession of religion, there have been fewer instances of scandal and apostasy than might be expected. So that, as far as we are able to form a judgment, the face of Religion is lately changed much for the better in many of our towns and congregations."

Similar testimonies could be multiplied at pleasure.

The present essay when complete will contain three parts. Of the two parts now published, the first is an analysis of the conversion process; it is divided into six subdivisions, corresponding to the natural phases of the experience: The Sense of Sin, Self-surrender, Faith, Joy, Appearance of Newness, The Rôle of the Will. In Part II we place, side by side, the Christian doctrines concerning Justification, Faith, the Grace of God, the Freedom of the Will, and the corresponding facts as they appear in Part I.

Part I. Analysis of Conversion.

1. Sense of Sin.[1] The sense of sin is the first manifestation of the religious experience ending in conversion. That the phrase "to be under conviction of sin" means more than mere knowledge of one's imperfections, we shall see presently.

[1] To have the full meaning of the quotations introduced in the following pages, the reader will have to refer to the complete account of the conversions given in the appendix. In them the age, education, state of health, etc., of the subject will be found, together with the circumstances of his conversion. We shall assume, for the sake of brevity, that the reader has perused these records.

For an investigation into the nature and the physiological basis of the sense of sin, see Part III.

The primitive and immediate sin-quale is variously modified by the affective value of diverse ideas concerning the nature and consequences of sin. Our records class themselves in two groups: one composed of those in which the *natural* sin-pain is altered and intensified by the belief that a divine Judge has pronounced sentence, it becomes sense of guilt and of condemnation; to these, God is first of all a Judge. The other group is made up of persons who, having escaped theological teaching, stand in the truth of nature, and of those who have outgrown its artificial instruction; for these, guilt, condemnation, fear of judgment, the need of pardon, do not exist; their experience remains untinged by speculative beliefs: they feel their sinfulness, *i. e.*, their physical and moral misery, their inability to do what they feel to be right and desire to do; they want deliverance,—of pardon they have no thought. To them God is a Helper, a Saviour, and not a Judge. To the first group salvation is a state that follows upon a legal transaction; to the second salvation is essentially a subjective affair: it is deliverance, now and for earthly life, from besetting sins.

It does not appear that the conception of God as a Judge by whom man stands condemned to eternal perdition, is particularly efficacious; it proves much less powerful than the idea of the loving Fatherhood of God. Henry Ward Beecher deplores having been imbued in his youth with these Calvinistic ideas, and thinks they retarded his entrance into the Christian life. "I thought I was an awful transgressor; every little fault seemed to make a dreadful sin; and I would say to myself, 'There! I am probably one of the reprobate.'" "For a sinner that had repented, it was thought there was pardon; but how to repent is the very thing I did not know. . . . . So I used to live in perpetual fear and dread, and often wished myself dead." . . "My feeling [at the age of fifteen] was such that if dragging myself on my belly through the street had promised any chance of resulting in good, I would have done it.". . . "If I had had the influence of a discreet, sympathetic Christian person to brood over and help and encourage me, I should have been a Christian child from my mother's lap, I am persuaded."[1]

We begin with quoting some experiences belonging to the first of these two groups. Edwards describes as follows the manner in which persons are wrought upon: "Persons are first awakened with a sense of their miserable condition by

[1] "Beecher's Biography," by Wm. C. Beecher and Rev. S. Scoville.

nature, the danger they are in of perishing eternally, and that it is of great importance to them that they escape speedily." . . . He speaks of his own sense of sin in very strong terms: "When others have expressed the sense they have had of their own wickedness, by saying that it seemed to them that they were as bad as the devil himself, I thought their expression seemed exceedingly faint and feeble to represent my wickedness, ... *and yet.* . . . *it is enough to amaze me that I have no more sense of my sin.*" A rather strange passage!

The Calvinistic doctrines when preached without palliation were amply sufficient to produce tragic fears and induce grave bodily disorders. The terror produced by the thought of yawning hell, ready to engulf the sinner, would dispose to submission to whatever remedy might be offered, but would not love have had a still greater potency? When fear becomes extreme, as under the ministration of Revivalists of the past centuries, it hinders the saving transformation. Expressions as strong as the following are common in the religious literature of the last two hundred years: . . . "The Lord seemed to run upon him, like a giant, throwing him to the ground, and with such a terrible discovery of sin, caused him to roar in anguish and oft rise in the night on that account, which continued for diverse months."[1] Every one knows the rôle these morbid fears played in the hysterical manifestations which have so often disgraced Revivals.[2] Concerning such "bodily exercises" Edwards wrote: ". . . . they have often suffered many needless distresses of thought, in which Satan probably has a great hand, to entangle them, . . . and sometimes the distemper of melancholy has been evidently mixed, of which, when it happens, the tempter seems to make great advantages." . . . But we cannot dwell on this interesting chapter; let us pass to more normal experiences of the sense of sin.

Finney: "I became very restless. A little consideration convinced me that I was by no means in a state of mind to go to heaven, if I should die. . . . . On a Sabbath evening in the autumn of 1821, I made up my mind that I would settle the question of my soul's salvation at once, that, if it were possible, *I would make my peace* with God." Some days later, going in the morning to his office, he was assailed by such questions as: "What are you waiting for? Did you not promise to give your heart

[1] "The Fulfilling of the Scriptures," Flemming, ed. 1671.

[2] See, for instance, pp. 131-169 on the Kentucky Revival of 1800, in "History of the Presbyterian Church," by Davidson, 1847.

to God? Are you endeavoring to work out a righteousness of your own?" *P.* had a very clear and vivid idea of sin. He was kept awake and tossed in bed, for fear of the Judgment. He knew he would be lost. The most potent influence was the thought of the Judgment itself, not the fear of punishment. *M.*: "As I saw myself drifting down, and friends who at one time would have gladly recognized and courted my company shunned me, I sometimes was almost at the point of asking God to forgive me and *make me a better man.* . . . . I became a wreck, separated from wife and children. Poverty stared me in the face almost always." . . At a later period he had one night a vision of God: "He said to me, 'Thus far shalt thou go and no further. You have despised Me and my Son. You have gone into the ways of sin and death. Now you are guilty and condemned.' And as I lay on my back on the bed, it seemed as if every sin I had committed came up before me. God spoke again as at first and added: 'If you will turn to Me now, I will forgive you.'" (See also appendix, case of *A.*) *F.*, on hearing a sermon on Luke x:42, feels that there was something else needed in his life, "the sermon had made me feel miserable. . . . My moral disposition was somewhat crushed by the sense of my sin. . . . On Feb. 24th between 11 and 12 A. M., I could bear the weight of my sins no longer. . . . . I was affected most by my sins and my Saviour's great love."

In the second group we shall see the sense of sin in a more natural aspect:—St. Augustine has not a thought for his happiness or misery in a future life. He lives in his subjective reality; condemnation and punishment he ignores. God compels him to see himself. . . . "setting me before my face, that I might see how foul I was, how crooked and defiled, bespotted and ulcerous. And I beheld and stood aghast; and whither to flee from myself I found not. And if I sought to turn my eyes off from myself. . . . Thou again didst set me over against myself and thrustedst me before my eyes, that I might find out mine iniquity and hate it. . . . . What said I not against myself? With what scourge of condemnation lashed I not my soul, that it might follow me striving to go after Thee! . . . . I was troubled in spirit, most vehemently indignant that I entered not into Thy will and covenant, O my God!"[1]

John B. Gough, the famous temperance orator, is moved to renovation by his misery, by nothing else: "I had no hope of ever becoming a respectable man again—not the slightest—for it appeared to me that every chance of restoration to

[1] "Confessions of St. Augustine."

decent society and of reformation were gone forever. . . Utterly wretched and abandoned, I have stood by the railway track with a vague wish to lie across it, drink myself into oblivion, and let the cars go over me."[1] *G.'s* condition was as pitiable as that of Gough when he arrived in Worcester. The kindness of a lady made him look within. He thought that "if there was a God that could save a drunkard, I would let Him." "I had no other thought but that if there was a God disposed to save me, I would let Him. I said, 'Here I am.'"[2] In the experience of *O.* will not be found a word referring to the need of pardon, or fear of punishment; he wanted deliverance from the shame and degradation of drunkenness, that was all. *L.* wrote: "I had no desire for anything good, only at times there would come a longing in my heart for something better. But it was soon over, and I would, if possible, go deeper into sin." Later, when he realized that if he continued in the same way he would die, he sought for salvation; "I did not realize that I was a sinner, only that I was a drunkard. And I think my prayer was, 'O Lord, take away this appetite, I cannot do it myself.'" *K.* has but one thought—to become good: "God sent an arrow of conviction to my soul, and for the first time I saw it as God sees it; O, how vile and black my heart looked! I thought that I would give the whole world to become as good as those Salvation Army people." *I.:* "When I got utterly hopeless, helpless, in the darkest despair, when I felt the slavery of sin . . . . when I knew that I was utterly and forever lost, . . . then God raised up a human instrument. My employer put me in the Christian home [for intemperate men]. . . I wanted to escape from the evil effects of my sins, in my physical life, but I do not especially recollect any desire to seek deliverance from all my sinful nature." Referring to his conversion he says, "Yet I believe that the thought was more to escape from the bondage of the appetite for drink than from the whole sinful man." *E.:* "In all this period [up to conversion], I never had a desire to reform on religious grounds, but all my pangs were due to some terrible remorse I used to feel after a heavy carousal; the remorse taking the shape of regret after my folly in wasting my life in such a way — a man of superior talents and education." During the conversion-crisis he was shown that he had "never touched the *eternal*, *i. e.*, God, and that, if I died then, I must inevitably be lost:" . . . "there was no terror in

[1] John B. Gough, "Autobiography."

[2] A little before he had said that during that night memorable to him, he knew that if he died, he would go to hell.

it; I felt God's love so powerfully upon me that only a mighty sorrow crept over me that I had lost all through my own folly, and what was I to do? What could I do? I did not repent even. God never asked me to repent. All I felt was I am undone, and God cannot help it, although He loves me. No fault on the part of the Almighty."

In the chapter on the Sense of Sin in Part III, we attempt an analysis of the feeling of sin; here we desire to remark only that the conglomerate of affective experiences known by that name — made up essentially of general physical discomforts due to unhealthy living (the yearning of the flesh after righteousness), and of conflicting moral tendencies, whose painfulness has also its physical basis — is in many, perhaps in most, cases complicated with the affective value of various theological conceptions, such as responsibility to a divine Judge, possible condemnation to eternal misery, etc. Although these ideas originally derive their *reality timbre* from the elemental sense of sin, yet, strangely enough, when they are once accredited, they frequently supplant it by the powerful emotional reaction they arouse, and the grosser emotions of apprehension and fear pass for the sense of sin. As, in many cases, these primitively anthropomorphic conceptions are ignored without apparent detriment to the progress of the Regeneration-process, the natural and immediate working of the sense of sin might safely be trusted.

2. Self-Surrender. Self-surrender is the turning-point in conversion. We might expect to find the will striving with increased ardor as its antagonists yield ground. Strangely enough, that which we commonly term "will" seems to weaken as deliverance approaches, and, against all expectation, the victory is won when the self-assertiveness of the individual has given place to complete resignation to "the will of God." This self-surrender motive is generally considered an essential condition of the higher religious life :—

> When all that separated from God is taken away, when every inordinate desire has undergone the process of excision, so as to be reduced into its place, and to be put into entire position and agreement with one great and overruling desire of conformity to God's will, then begins the new life in the higher sense of the term. The soul no longer possesses anything which it calls its own, but may rather be spoken of as a *subject*, and instead of possessing, may be said to be possessed by another. Disrobed of the life of nature, it is clothed with the life of grace.—From "Correspondences of Faith and Views of Mme. Guyon," by Henry T. Cheever.
>
> Confidence and resignation, the sense of subjection to a higher will which rules the course of events, but which we do not fully comprehend, are the fundamental principles of every better re-

ligion.—"Unterhaltungen" of Goethe with Chancellor Müller, p. 131. Resignation to the will of God is the whole of piety. . . . . Our resignation may be said to be perfect when we rest in His will as our end, as being itself most just and right and good.—"Fifteen Sermons," by Joseph Butler, Lord Bishop of Durham. Sermon on the Love of God.

In the famous "Sure Guide to Heaven" of Joseph Alleine, we find among the directions for Salvation: "Resign up all thy powers and faculties and thy whole interest to be His." The current phrases: "to accept or receive Christ," "to yield one's self to God," or the like, are expressive of the same psychological reality.

At this point of the conversion-process the sense of sin, of impotency, of dependence, is about to pass over into confidence, trust, love and joy. Let us attempt an analysis of this turning-point and its surroundings.

In his "Confessions" we see St. Augustine violently lamenting over his double-direction will. For a number of years his sense of duality had grown in intensity. When the final crisis is upon him, he is clearly aware of the one remaining thing that prevents him from "entering into God's will and covenant." "The very toys of toys and vanities of vanities, my ancient mistresses, still held me; they plucked my fleshly garment and whispered softly, 'Dost thou cast us off; from that moment shall not this or that be lawful for thee forever?'" It seems that this desire was the last bond that prevented the realization of the peace he sought. From this moment the struggle becomes a tug-of-war between two currents, two classes of affections: the love of his mistresses and the love of God.

"But now it spoke very faintly [the voice of his mistresses]. For on that side whither I had set my face and whither I trembled to go, there appeared unto me the chaste dignity of continency, serene, yet not relaxedly gay, honestly alluring me to come and doubt not, ... and she smiled on me [and said]. . . . . cast thyself upon Him, fear not, He will not withdraw Himself that thou shouldst fall; cast thyself fearlessly upon Him, He will receive and will heal thee! And I blushed exceedingly, for that I yet heard the muttering of those toys, and hung in suspense." The struggle goes on; "a mighty storm, bringing a shower of tears," supervenes and indicates the progress of surrendering. But trust in God's forgiveness, and in His readiness to deliver him from his sin is not yet complete. He exclaims: "'And Thou, O Lord—how long? how long, Lord, wilt thou be angry, forever? Remember not our former iniquities,' for I felt that I was held by them. I sent up these sorrowful words: 'How long? how long? to-morrow and to-morrow? Why not now? why is there not this hour an end

to my uncleanness ?' " Presently he thinks he hears a voice telling him to take up and read the word of God. This supposed manifestation of God's interest works hope and faith in him, for he remembers one Antony who was converted through an oracle. The first passage on which his eyes fall is, "Not in rioting and drunkenness, not in chambering and wantonness, not in strifes and envyings; but put ye on the Lord Jesus Christ, and make not provision for the flesh in concupiscence." "Instantly at the end of this sentence, by a light, as it were, of serenity infused into my heart, all the darkness of doubt vanished away," and now what he feared to be parted from, his mistresses, had become a joy to part with. This voice and this passage, taken as indication of God's paternal care for him, contributed the impulse yet lacking to enable him to achieve the sacrifice of that which had been for years his delight. Self-surrender was absolute; consciousness unified; joy and peace followed in the track of grief and bitter contrition. That day St. Augustine began his Christian career. We note that the transformation took place when the last inhibition to the godward current gave way. Until then no peace, no unity, no conversion.

It should be noticed that although the conversion-conflict may be compared to the daily moral struggles with which we are all familiar, it differs from them in some such way as a fight to the death differs from a fight for first blood. In the latter case the whole man is not involved, only a few eccentric cells and nerve paths are in play. It is a skirmish of some stray soldiers. In the former event, the hostile individuals have been gathering from all over the land, leaving no stragglers behind. Every one has been called upon to join one or the other of the armies, and now the conflict is final: the issue involves the whole man, every cell and nerve fibre. One by one the divisions of the weaker army are destroyed, until there remains but the main body, and then the final crisis comes. In the case we have just considered, every conscious resistance but one had yielded; this one overpowered, the victory is complete, the land passes under a new ruler. Henceforth all strife ceases; harmony, a sense of unity and corresponding joy pervade the organism. Everything becomes new, the foreign as well as the internal policy has changed, and a new organic life begins.

It is evident that although the consciousness of sin is specifically the same in every individual, the particular points at issue may differ very much. But whatever it may be, the tendency, or the direction of the effort, is always the same: unification of consciousness through the subjection of a class of desires in opposition to another class of desires.

In the case of Finney the opposing tendencies finally crystallize around one well defined feeling, *pride*. His unwillingness to be seen praying betrays unreadiness to abandon himself absolutely to the promptings of God's spirit, and to espouse without reserve all the consequences and results involved in the new relation to God which he craves. This inhibition, although trivial in its external aspect, brings to light the fundamental resistance: consideration for self, self-assertion.

He knew in a general way what was required of him. "I had to submit myself to the righteousness of God through Christ." To conceal himself from possible passers-by he creeps into a space left open between two large trees fallen to the ground. "In attempting to pray I would hear a rustling in the leaves, as I thought, and would stop and look up to see if somebody were not coming. This I did several times. . . . Finally I found myself verging fast to despair. . . I began to feel deeply that it was too late, that it must be that I was given up of God and was past hope. . . . I again thought I heard some one approach me, and I opened my eyes to see whether it were so. But right there the revelation of my pride of heart, as the great difficulty that stood in the way, was distinctly shown to me. An overwhelming sense of my wickedness in being ashamed to have a human being see me on my knees before God, took such powerful possession of me that I cried at the top of my voice, and exclaimed that I would not leave that place if all the men on earth and all the devils in hell surrounded me. . . . The sin appeared awful and infinite. It broke me down before the Lord." At that instant a passage of the Bible comes to his mind and brings a flood of light, and Finney finds himself for the first time in the possession of a heart-faith which fills him with peace and the assurance of salvation. Self-annihilation, absolute self-surrender brought with it joy beyond words, the sense of confidence in God—*Faith*—and of pardon. Pride is often the centre of the residual resistance.

The sense of sin, as we have observed in the preceding chapter, is at times little more than a feeling of physical misery, the anguish of the sickened flesh. In such cases the expressions "regret" and "desire for relief" should properly take the place of "remorse" and of "repentance," which designate experiences modified by specific intellectual considerations ignored by the persons we speak of. This primitive consciousness is especially noticeable in persons addicted to some gross vice. Drunkards, for instance, frequently show no sign of the sense of condemnation, although fully aware of their utter

worthlessness. They feel shame at their degradation, but are not conscious of any responsibility towards God for breaking His laws. They do not exclaim, "Oh, my sins, my sins!" but rather: "Oh, cursed wretch that I am!" The ideas of punishment, of eternal death or of damnation make no impression upon them; the realities of their daily life go beyond the pictorial power of imagination. What they want is deliverance—deliverance from the unbearable misery of this life.

Let us examine, with reference to self-surrender, the regeneration of some grossly vicious persons.

S. H. Hadley, superintendent of the old Jerry McAuley Water Street Mission:—Thirteen years ago, in the Water Street Mission in New York city, after having listened to twenty-five or thirty persons relating in words burning with earnestness their deliverance from dypsomania, he made up his mind that he "would be saved or die right there!" When the invitation was given for those desiring to reform, to come forward, he accepted the call and knelt down at the foot of the platform with a number of other drunkards "How I wondered if I would be saved! if God would help me! I was a total stranger; but I felt I had sympathy, and it helped me. Jerry [the famous Jerry McAuley] made the first prayer. I shall never forget it. He said: 'Dear Saviour, won't you look down in pity on these poor souls? They need your help, Lord; they can't get along without it. Blessed Jesus, these poor sinners have got themselves into a bad hole. Won't you help them out? Speak to them, Lord, do, for Jesus' sake—amen!'" Then they were asked to pray for themselves. "How I trembled as he approached me! Though I had knelt down with the determination to give my heart to God, when it came to the very moment of grand decision, I felt like backing out. The devil knelt by my side and whispered in my ear crimes I had forgotten for months: 'What are you going to do about such and such matters if you start to be a Christian to-night? Now you cannot afford to make a mistake; had not you better think this matter over and try to fix up some of the troubles you are in, and then start?' Oh what a conflict was going on in my poor soul! A blessed whisper said, 'Come!' The devil said, 'Be careful!' Jerry's hand was on my head. He said, 'Brother, pray.' I said, 'Can't you pray for me?' Jerry said, 'All the prayers in the world won't save you unless you pray for yourself.' I halted but a moment, and then, with a breaking heart, I said: 'Dear Jesus, can you help me?' Dear reader, never with mortal tongue can I describe that moment. Although up to that moment my soul had been filled with indescribable gloom, I felt the glorious brightness of the noonday sun

shine into my heart; I felt I was a free man. Oh, the precious feeling of safety, of freedom, of resting on Jesus! . . . . From that moment till now I have never wanted a drink of whiskey." This man has given his life to the rescue of drunkards. In this record the approach towards complete surrender can be followed step by step. He had laid aside pride enough to respond to the invitation and thereby confess publicly his inability to cease drinking. Old crimes, and that which the settlement of them will require of him, pass before his mind; for a moment he hesitates to accept the attitude towards them which submission to God would demand. His humble prayer for succor, and its effect, indicate that all the resistance of which he was conscious had given way, and that, as he called upon Christ, he threw himself unreservedly at his feet.

Case of *O.* (Appendix.) After every drinking-bout until the last, *O.* felt confident that he would be able to restrain his appetite. The sorrow and deep shame that accompanied his last debauch were also experienced after the preceding ones, but the *one* characteristic element of this last post-debauch state was that all hopes of self-deliverance had left him. For the first time he felt convinced that his passion was stronger than his determination; the light that had illumined the horizon had gone out; the future was all darkness; no effort of his could avert the coming calamity. In that state of will-surrender he turned his doubting thoughts to God for help, ready, as he has said to me, to do whatever God would require of him. In this attitude he found the strength he lacked.

Case of *E.* (Appendix.) An Oxford graduate, the son of a clergyman of the Church of England. "About mid-day I made on my knees the first prayer before God for twenty years. I did not ask to be forgiven; I felt that was no good, for I would be sure to fall again. Well, what did I do? *I committed myself to Him in the profoundest belief that my individuality was going to be destroyed*, that He would take all from me, *and I was willing.* In such a surrender lies the secret of a holy life. From that hour drink has had no terrors for me; I never touch it, never want it. The same thing occurred with my pipe: after being a regular smoker from my twelfth year, the desire for it went at once and has never returned. So with every known sin, the deliverance in each case being permanent and complete. . . . . Since I gave up to God all ownership in my own life, He has guided me in a thousand ways, and has opened my path for me in a way almost incredible to those who do not enjoy the blessing of a truly surrendered life."

Case of *K.* (Appendix.) A colored man. "I began attending

their meetings [the Salvation Army meetings] in the Opera House. The oftener I went, the more miserable I became; but I could not stay away; there seemed to be some unseen power that forced me to go, and so I went until I could endure it no longer. The night I went to the altar it seemed to me it was a last chance for me. I went to the altar to give my heart to God, not a part, but every idol, my time, my talents, and all. I made a full surrender of everything, and God for Christ's sake set my captive soul free. . . . My pen fails me to describe the joy that thrilled my soul. . . . ."[1]

The preceding cases illustrate conversions in which resistance focuses on one special vice. The struggle is against one well determined appetite or desire. In the generality of cases this concentration is not apparent; the subject is in presence of his sinful tendencies; no particular sin is singled out. The following are examples of such diffused sin-consciousness:

Eleanor Emerson in the course of her awakening came to the discovery that "all my external goodness sprung from the motives of self-exaltation; or, what is still more displeasing to God, that it was designed as a substitute for the righteousness of Christ." She tried repeatedly to "reconcile myself to the idea of being in His hand as the clay in the hand of the potter. But, alas, I found this idea more and more dreadful." The prayer meeting, where she knew she would be urged to make a decision and yield herself to the solicitation of God's voice, was a terror to her soul. Although she had determined to attend no more, being one day invited, she concluded to go for the last time. not, however, from a commendable motive, and "in all the obstinacy of despair to hold up my head, which had long been bowed down, like a bulrush." Various feelings agitated her during the meeting: "My soul seemed humbled in the dust in view of my condemnation; while I was constrained to cry in spirit, 'Even so, Lord Almighty, true and righteous are Thy judgments!' At this view of my wretched, hopeless situation, the following words passed sweetly through my mind, and with such delightful energy as thrilled through my whole soul, and filled me with rapture unspeakable:

'Jesus, to thy dear faithful hand,
My naked soul I trust.'

[1] The person through whom this testimony was secured, writes: "He was a very bad man and, since conversion, he has lived honestly for nine years. He was the keeper of a saloon and gambling den, and, of course, gave up that means of support. He has since struggled with poverty, ill-health, and old age. I have been profoundly impressed with the mystery of an experience like his."

"At this most cordial disposal of myself into the hand of a glorious Redeemer, the thick clouds seemed to disperse, and give place to such a transporting view of the glorious Saviour as no words can express."

The crisis of John Wesley as he describes it in his journal, is in every essential respect analogous to the preceding one. Until the event called his conversion, he had not obtained that organic transformation which works unity in the moral consciousness. In his famous letter to Law he describes himself as groaning under the effort to fulfill the works of the law and to find in them peace and justification. Elsewhere he says, "In this refined way of trusting to my own works and my own righteousness, I dragged on heavily, finding no comfort or help therein." For a number of weeks preceding his conversion, he was thoroughly convinced that he was not a Christian, and that he needed a radical change to become one. He resolved to seek the living faith by absolutely renouncing all dependence, in whole or in part, upon his own works of righteousness, on which he had really grounded his hope of salvation, though he knew it not, he tells us; and by praying continually for a full reliance on the blood of Christ shed for him as his sole justification. He found that assurance about a quarter before nine Wednesday, May 24th, 1738, according to his own statement. Whitefield's experience, as far as it is recorded, conforms with that of Wesley.

Case of *P.* (Appendix.) Had lost all hope of salvation; his uppermost thought in the meeting in which what follows took place, was that he would never be able to obtain pardon and salvation. At the close of the sermon the minister started the hymn, "Just as I am, without one plea."[1] He joined in the singing. Suddenly the Spirit of God—to use his own expression—seemed to make every word of that first line work within him. He felt the depth of its meaning and its truth regarding him. With all his heart he sang: "Without one plea," and realized as he had never done that Jesus Christ's sacrifice was for his benefit, that he also was intended to be saved; Christ was calling for him. These thoughts and their accompanying feelings flashed like lightning upon him while the singing proceeded. The last line expressed his very desire, "O Lamb of God, I come, I come." Before the last word of the first stanza was pronounced, he realized that his

[1] "Just as I am,—without one plea,
But that thy blood was shed for me,
And that thou bidd'st me come to Thee,
O Lamb of God, I come."

sins were forgiven and that he was saved. When, while the second verse was being sung, the pastor, walking down the aisle, stopped near him, arrested by his illumined face—and offering his hand said, "You are a Christian"—"Yes, sir," he responded from the fullness of his heart; a minute before he had despaired of ever being saved.

What was required from Rev. J. O. Peck was—as he thought — his consecration to God's service. "Sharp and short the struggle. Then and there, I dropped on my knees and dedicated myself to God's service from that hour. I prayed until I felt peace with God through our Lord Jesus Christ. When I arose the storm had ceased and the sun was shining. I was in a new world, etc."

We have chosen the preceding cases among many for the clearness with which they set forth the self-surrender movement. Many others might be added nearly as explicit, for instance: "I yielded myself to what I conceived to be Higher Guidance. I yielded with trembling, but with importunity. At the close of the period I found myself at one with all things." Or, "I found my heart glowing with the most ardent love towards the Saviour. Tears flowed without control. The language of my heart was, O my dear Saviour, come and take everlasting possession of my soul. . . ." The verbal expressions vary, but their purport is always the same: I feel, realize, my absolute incapacity to live righteously by my own endeavors; it is all over, I am undone. From my efforts can come no righteousness, no peace, no salvation; now, I lay down my arms and am unreservedly ready to do whatever Thou shalt command. This attitude corresponds to a peculiar physiological condition.

The self-surrender movement may not be always explicitly mentioned, but it is always implied in what is expressed; for instance, in such sentences as the following: "I did not dare to give myself wholly to Him"—(Dr. John Livingstone); or, "I cannot say that I felt strong, but rather weak like a child, and yet not in a sense that I must sin"—(*J.*); or many expressions of *M.* and of *I.* in the story of their remarkable transformation; or in Jonathan Edwards' striking expression that God's absolute sovereignty and justice with respect to salvation and damnation has often appeared to him *delightful!* (See Edwards' Conversion.) The attitude of absolute dependence could not be more beautifully expressed. Man's reason revolts against the abuse of power of a Creator who dooms his creatures to endless perdition, before the foundation of the world. But Edwards' "abandon" to the will of God gives him such a sweet trust and peace that even this apparently fiendish decree brings delight to his heart.

He is the lover who, careless of the fate awaiting him, gives himself up to fond embraces, and would find even death acceptable were it to come from the hands of the beloved.

The following observation from "A Narrative of Surprising Conversions in Northampton," by Edwards, deserves quotation here: "The drift of the Spirit of God in His legal strivings with persons, has seemed most evidently to be to make way for, and to bring to, a conviction of their absolute dependence on His Sovereign power and grace and the universal need of a Mediator, by leading them more and more to a sense of their exceeding wickedness and guiltiness in His sight: . . . . that they can in no wise help themselves, and that God would be wholly just and righteous in rejecting them, . . . and in casting them off forever. . . . ."

A considerable part of our material having come from individuals of common school education, and conversion being often related after a considerable interval from its occurrence, it cannot be expected that every subject will be able to dissect his experience finely enough to set forth clearly the various phases of so complicated a process. The difficulty of introspection is extreme because of the emotional tempest that usually reigns at the time. A gentleman of fair culture answered as follows question five: "I think some of the questions under No. 5 are rather ridiculous, as if a person could remember the various thoughts and feelings in his mind and heart at the moment of conversion!" Despite this difficulty, surrender is explicitly mentioned in most of the records.

The reader has likely noticed the striking diversity in the feelings apparently uppermost in the conversion-experience of various persons. Some give prominence to their desire for humility; others are absorbed in the feeling of their impotency and unutterable woe; still others are annihilated and lie prostrate in complete self-surrender, while the attention of some is held by the warmth of confidence, — they speak of hope, of trust; and still others seem to ignore humility and their powerlessness, and are carried on by a love impulse to faith in God and Christ. The words sin, humility, impotency, utter wretchedness, despair, self-surrender, hope, trust, love, faith — in the order we have placed them — mark in a rough way stages in the evolution of the conversion-process. According to one's temperament and disposition, or depending upon more trivial circumstances, certain phases of it stand out in more intense color and occupy longer the field of consciousness. It is evident that humiliation cannot precede, but will follow upon the discovery of one's own wickedness; that impotency will be realized only after repeated defeats; that it may be

accompanied by despair; that absolute self-surrender can be consented to only when the former stage has been realized, and that living faith, born of loving confidence, cannot precede, but may follow upon the realization of the need of help. These words, then, describe the stages of a continuous process. That process may stop anywhere and never be completed, as in the case of most men. Although it must be looked upon as continuous, there is in it a turning point which divides it into two parts: the "way down" and the "way up;" or the "negative" and the "positive" phase. Between absolute surrender at the end of the way down and the first glimpse of hope, constituting the first step of the second part of the process, there is a change of direction. That change is *conversion*, if one wishes to use the word in its strict etymological meaning; and the positive phase is properly called *regeneration;* it might be termed *atonement;* while the negative stage might be named *diremption*. Although it may seem that there is no necessary link between the end of the way down and the beginning of the way up, the process never comes to an end at this point, while it frequently stops somewhere in the negative phase. There are, nevertheless, a number of cases where what appears to be complete self-surrender is not immediately followed by the advent of the upward-move. Confidence and trust, love, are made impossible by some inhibition, as in the case of Livingstone, who could not believe that the Lord Jesus was willing to receive and save a wretch who had resisted His grace so long; or in that of Bunyan, who for years did not know whether he was included among the elect or not. Gardiner, after being delivered from his sin, had no joy because he did not know whether eternal damnation was not properly to be his lot. But it should not be thought that the efficient cause of the arrest of the process is necessarily an intellectual doubt. Much, rather, are the doubts the token of a remaining inward resistance, ignored perhaps by the subject.

3. Faith. We have seen that when self-surrender is complete, a turning point is reached at which the affective state changes *toto cœlo*. Despair, guilt and the feeling of isolation are superseded by joy, the sense of forgiveness, confidence and faith. This small word "Faith" has probably received more attention in Christian countries than any other word belonging to religion, if we except the names "God" and "Jesus." "He that believeth on the Son hath everlasting life" (John iii:36)—"Justification by Faith"—"The just shall live by Faith"—"Believe [have Faith] and thou shalt be saved."—From generation to generation these mighty phrases

have filled the mouths of Christians; they have passed from heart to heart and quickened them to better living; about this word, endless discussions have arisen and momentous battles have been fought, councils have decreed, creeds have been built up. This word must have a potency of meaning adequate to the rôle it has played; to what psychological reality does it correspond?

The most perplexing confusion reigns as to the use of the terms "belief," "faith," "knowledge." There is in religious circles a deep-rooted conviction that there exists a something different from intellectual belief and knowledge; that obscure *something* is, by general agreement, called Faith; but what that mysterious word means is too vaguely perceived, it seems, to allow of a consistent use of clearly differentiated terms. One defines Faith as "the intuition of eternal verities," another as "the organ for the supernatural and divine;" the definition in Hebrews xi:1 is known to all. Others enlarge it to make it simply a "conviction of truth founded on testimony," and use "belief" as synonymous with "faith;" for instance, Hodge in his "Systematic Theology," and the English Bible.

Assuming at the beginning of our investigation that there is a specific psychic state which is, or can be, accompanied by certainty as to the reality of intellectual conceptions, religious or other (a certainty not secured by the ordinary processes of the mind when seeking to arrive at scientific truth), we shall designate this negatively defined unknown by "Faith," to distinguish it from opinion, belief and knowledge. These three words — opinion, belief, knowledge — we regard as denoting various degrees of conviction resting on grounds of the same nature, *i. e.*, on rational cognition. Thus we may escape confusion and ambiguity. Furthermore, for the sake of simplification, we shall designate by the word "belief" the class containing these three subdivisions.

We are not concerned here with the psychology of faith and of belief in general, but only in as far as they are found in conversion.

The great Jonathan Edwards furnishes an interesting contribution to this part of our study. "From my childhood up, my mind has been full of objections against the doctrine of God's Sovereignty, in choosing whom He would to eternal life, and rejecting whom He pleased; leaving them eternally to perish and be everlastingly tormented in hell. It used to appear like a horrible doctrine to me. But I remember the time very well when I seemed to be convinced and fully satisfied as to this Sovereignty of God, and His justice in thus eternally disposing of men, according to His Sovereign pleasure.

But never could give an account how, or by what means, I was thus convinced, not in the least imagining at the time, nor a long time after, that there was any extraordinary influence of God's Spirit in it; but only that now I saw further, and my reason apprehended the justice and reasonableness of it."[1]

Reason convinced without any intellectual argument by the extraordinary influence of God: this is the work of Faith. We note in this experience the complete absence of the intellectual process by which scientific conviction is produced. The following[2] (case of *B.* in appendix) describes the experience of a clergyman now in the prime of life:

". . . . For three days the wild tide swept and surged past and around me. I felt I must give up the Gospel of John and, if so, my Christian faith also; and with this the universe would go. . . . . I yielded myself to what I conceived to be Higher Guidance. . . . At the close of the period I found myself at one with all things. Peace, that was all. . . . . When I looked at myself, I found that I was standing on the old ground, but cherishing a toleration of doubt and a sincere sympathy with doubters such as I had never known before. . . . . I could take the logical standpoint, and could see that they were quite convincing [the arguments], and yet my inward peace of belief was in no way disturbed." . . In this case, arguments bring to the ground a system of beliefs. After an emotional crisis, in which criticism plays no part, the old intellectual construction is found standing firmly, in spite of blows and buffets more than reasonably able to throw it down. The ground of belief has undergone a specific change; arguments no more affect the new structure than blows affect a shadow. It is no longer belief, it has become an object of Faith.

Few religious experiences are as perplexing to a class of earnest Christians as that of John Wesley. At the age of thirty-five, after having served zealously and successfully in the ministry of the English church for ten years, and attaining, by constancy of purpose in the pursuit of holiness, the moral worthiness which he himself avows in the searching of heart made soon after his return from Georgia to England, he repeatedly declares that he is not a Christian. Not that he experienced doubts as to the Christian beliefs (he had doubts, it is true, on the ship when returning to America, but only such doubts as are unavoidable in simple belief.

[1] From the conversion of President Edwards.
[2] Communicated to us by Dr. Burnham.

They soon vanished and left him at complete rest as to the truth of the doctrines), but that his religious state, his inner unsatisfied needs, a duality, compelled him to recognize that to be a Christian was to be more than what he was. "But does all this [his devoted and self-sacrificing labors] make one acceptable to God? Does all I ever did or can know, say, give, do, suffer, justify me in His sight? or . . . . . that I am as touching outward, moral righteousness, blameless? or (to come closer yet) *the having a rational conviction of all the truths of Christianity?* Does all this give a claim to the holy, heavenly, divine character of a Christian? By no means. . . . . All these things, though when ennobled by faith in Christ, they are holy and just and good, yet without it are 'dung and dross.'" He concludes that he has "fallen short of the glory of God," and sets to work to find the Faith which he lacks. A long period of increasing self-abasement follows, "which must ever precede true, living faith in the Son of God," says his biographer. The sense of self-righteousness slowly dies, and he is brought to the point where complete self-surrender becomes possible. Then, suddenly, at a meeting, while some one was reading the famous Luther's preface to the Epistle to the Romans, "about a quarter before nine, while he was describing the change which God works in the heart, through faith in Christ, *I felt* my heart strangely warmed, I *felt* I did trust in Christ, Christ alone for Salvation; and an assurance was given me that He had taken away my sins, even mine, and had saved me from the law of sin and death."[1] Notice the use of the word *feel*:—a psycho-physiological transformation no more dependent upon intellectual information and belief than a sudden turn in the general condition of a patient depends upon the medical theories he holds. An interesting remark can be made here concerning the influence of suggestion: it is as the change which God works in the heart is being described that the very same transformation takes place in Wesley.

Doubts vanished from the mind of St. Augustine at the moment he gave up the last impediment to a holy life:[2] his unrighteous loves. Indeed, intellectual doubts played no part in the conversion to Christianity of this subtle dialectician. This inconsistent professor of intellectual conviction forgets his art when most needed, it seems, and receives

[1] From Wesley's journal as quoted in Moore's "Biography of Wesley."

[2] It would be in closer agreement with the facts to use the passive form and say: when the last impediment to a holy life gave way.

bodily the Christian doctrines on the strength of a change of heart! The victory over his passion becomes the ground of faith in doctrine. Who would wonder at his abandoning his profession after such a shaming experience of its uselessness! After the long struggles so acutely described in his "Confessions,"— a contest exclusively moral, as the reader may convince himself by refering to the account of his conversion, pp. 328 and 329, he finally reaches the point of complete self-surrender. Even those "very toys of toys and vanities of vanities," which were the obstacle to the unification of his life-motive, he is now able to renounce; thereupon, "by a light, as it were, of serenity, infused into my heart, all the darkness of doubt vanished away." The son of Monica has exchanged his vacillating belief for Faith; henceforth he is to devote himself to the triumph of the Gospel of Christ and the establishment of right religious beliefs.

The neuropathic Mrs. Eleanor Emerson thus glowingly describes her ecstatic feelings at the time of her conversion: "At this most cordial disposal of myself into the hand of a glorious Redeemer, the thick clouds seemed to disperse, and give place to such a transporting view of the glorious Saviour as no words can express. With an eye of faith I beheld the transcendent glory more conspicuous than that of the natural sun in meridian splendor, when bursting from behind the thickest clouds. I could no more doubt of the being and divinity of Christ than of my own existence. He was presented to my spiritual view in such substantial glory as caused me to adopt the exclamation of the astonished Thomas: 'My Lord and my God!' . . . The greatness of God's character and the glorious scheme of redemption filled me with wonder, admiration and joy." The belief in the divinity of Christ and the doctrines involved in the scheme of redemption, is made to pass, by that ecstatic irradiation supervening upon the removal of the last inhibition, into the domain of Faith.

Finney was convinced that "the Bible was the true word of God" and of the truth of the Christian doctrines respecting salvation before he thought himself a Christian; and yet he tells us that "in this state [the state he describes as the baptism of the Holy Ghost], I was taught the doctrine of justification by faith as a present experience. . . . Indeed, I did not know at all what it meant by the passage, 'Being justified by faith, we have peace with God through our Lord Jesus Christ.'" Neither did Luther understand justification by faith; tortured by his conscience and by an unsatisfied thirst for union with God, he writhed in agony until peace came and with it the *understanding* of salvation

by Faith. This living experience became the power of the Reformation and his chief stay against Rome's "salvation by works." It was also the centre of Finney's preaching as of all the great Revivals this country has known.[1]

Frequently, especially in persons of little intellectual development, conversion and Faith are not preceded by intellectual conviction of the truth of the Bible, of the divinity of Christ, of the atonement, etc.; there may be either absolute uncertainty about these doctrines, or even complete ignorance of their existence. Jonathan Edwards, whom this fact had not escaped, was a good deal perplexed and puzzled by this lack of deference on the part of the facts to theology. "It must needs be confessed that Christ is not always distinctly and explicitly thought of in the first sensible act of grace (though most commonly He is); but sometimes He is the object of the mind only implicitly. Thus sometimes when persons have seemed evidently to be stripped of all their own righteousness and to have stood self-condemned as guilty of death, they have been comforted with a joyful and satisfactory view that the mercy and grace of God are sufficient for them; that their sins, though never so great, shall be no hindrance to their being accepted; that there is mercy enough in God for the whole world, and the like, when they give no particular or distinct thought of Christ." (From a "Narrative of Surprising Conversions in Northampton.") But Edwards adds: *when questioned* "it appears that the revelation of the mercy of God in the Gospel, is the ground of their encouragement and hope," *i. e.*, they had not forgotten their catechism. From our observations we conclude that, in the city missions of to-day, belief in the divinity of Christ and in the atonement—not to speak of other doctrines—wield a very scanty influence, and is generally absent until after conversion, at which time the new Christian is generally instructed in the popular theology. I pressed *G.* with questions touching the religious beliefs that occupied his attention in any degree whatsoever during the night of his conversion and the preceding days, but could obtain nothing more than what is recorded. Although at the time of our interview he was well informed as to "Salvation by the blood of Christ," "Salvation by faith," and the atonement doctrine, the name of Christ

[1] "As regards the means used in this Revival (in Rochester), I would say that the doctrines preached were those that I always preached everywhere. The moral government of God was made prominent; and the necessity of an unqualified and universal acceptance of God's will as a rule of life; the acceptance by faith of the Lord Jesus Christ as the Saviour of the world, and in all His official relations and work; and the sanctification of the soul through or by truth."—From "Finney's Memoir."

appeared neither in the history of his life freely given, nor in answer to my questions. At the time the only things real to him were his misery, his complete helplessness, and a dubious hope that some mighty power called God might be willing and able to save him. The story of S. H. Hadley presents a similar mental state, as also the case of *O.*, who did not so much as mention Christ when relating his experience, and who stated that doctrines played no part in it, with the exception of the concept of God as a power, able and willing, perhaps, to succor him. Similar remarks can be made with reference to the great majority of that class of converts. The following quotation from Col. H. H. Hadley, well known in home-mission circles, the instrument of the reform of hundreds of drunkards, may interest the reader, if only by its picturesqueness: "Men have been converted in the delirium tremens. It knocks all the theology higher than a kite! I don't understand it, but it is so. Take my own case,—a big, bloated drunkard, had fifty-three drinks the day before I was converted, most of them brandy cocktails, and before me I saw my Lord crucified; I was converted."[1] I heard myself in a New York City Mission men tell that they had been converted while intoxicated, even to a considerable degree. I found satisfactory evidence that their story was correct, and that their conversion, judged by the newness of their life, was genuine. Subsequently similar facts came repeatedly to my knowledge.

As a last illustration of the rôle of intellectual beliefs in conversion, we report the harrowing experience of the famous temperance orator, John B. Gough, who, for twenty-six years, gave continuous proof of his moral regeneration (see appendix). Not the slightest comfort or help did he derive from the idea of God's goodness and readiness to help him. It is practically the conversion of an atheist: neither God nor Jesus Christ is mentioned. The sense of his degradation and worthlessness does not involve in his mind responsibility for sin to others; he is absorbed in his own self. He battles against himself, poor slave and outlaw, to conquer, if possible, the place he has lost in society. When the stranger spoke to him on a public street in Worcester, kindness, sympathy, the proof that all bonds between him and mankind were not cut off, and that men still had confidence in his manhood, lighted up the redeeming flame of Faith. "It was the first touch of kindness which I had known for months; and simple and trifling as the circumstances may appear to many, it went

[1] From a talk in Boston, reported by the *Boston Herald*, Feb. 6, 1895.

right to my heart, and like the wing of the angel, troubled the waters in that stagnant pool of affection." On the urgent request of the stranger, he resolves to sign again the abstinence pledge. "I said to myself: If it should be the last act of my life, I will perform my promise, and sign it, even though I die in the attempt, for that man has placed confidence in me, and on that account I love him." This time the Saviour was not Jesus Christ, but an humble restaurant-waiter. Names, persons and representations; a sympathetic fellow-man, Jesus Christ, or God, are practically one, in so far as they are able to determine the birth of the same life of love, of which the name, viewed from a slightly different position, reads "*Faith*." What imports is that the regenerating psychic process takes place; through what instrument, it matters little. As I remarked to a gentleman who was collecting data for me that the cases of conversion he had sent me showed a startling lack of discrimination between Christ and God, he answered, "To them God and Christ are one." Yes, indeed, and both owe their reality to *our* love and *our* need of love. They might be compared in this respect, without irreverence, to Dante's Beatrice, whose reality sprung from the poet's heart.

The case of *G.* falls in with that of Gough. The loving sympathy of a woman became in him the leaven of the new life.

We add some quotations picturing the affective condition of the "faithful." They come from individuals who had wandered far away from conventional righteousness. *R.* experienced a great peace of soul, a great quietude. Care for the future and remorse for the past disappeared. Love and thankfulness took their place. *S.* felt that "God guided him in all things; that He cared for everything which concerned him and relied confidently on Him, although during that period he was very poor, miserable, without proper clothing, and suffering from hunger." *H.:* "Since that moment joy has not failed him. He felt God in his heart, had the assurance that he was renewed by the Spirit of God. He was happy, even though at the time he had no shelter in which to spend the night. He had confidence that God would never forsake him." *T.:* "At the time of his conversion he felt that God was a Father, that He would care for him as for one of His children." The individual, until then isolated, separated from the world, finds himself at one with God. Adam, banished on account of sin, is readmitted to the presence of the Lord in the garden of Eden; a bond of love and confidence unites him to all creation. A. Fassler's autobiography, "Un Relèvement," is an

interesting illustration of the passage from the isolation of "selfness" and the accompanying practical and theoretical immorality to the sympathetic attitude and the new life it involves. How beautifully the life of St. Francis of Assisi expresses this oneness with nature, which none but the soul undivided by sin can enjoy. Meek Francis found in life the peace and unity which Christian and Buddhist ascetics sought in death. The deluded disciple of Buddha grows stolid and inane in the pursuit of Nirvana, while St. Francis' heart thrills at the sight of the very earth-worms; the trees of the forest, the star in distant heavens, the bird on the bough, every creature, dumb or speaking, moving or inanimate, is his brother or sister: "Praised be my Lord for Sister Moon and for the stars, which thou hast created in the heavens, clear and beautiful. Praised be my Lord for Brother Wind, for the air and the clouds, for the pure sky and for all time, which give life and sustenance to Thy creatures. . . . Happy they who shall be found conformed to Thy holy will, for the second death can do them no hurt." What most distinguishes Jesus Christ from other men is a more perfect sense of moral unity. He revealed the Fatherhood of God because he felt himself indeed the Beloved Son from whom the Father has no secret.

When the sense of estrangement, fencing man about in a narrowly limited ego, breaks down, the individual finds himself "at one with all creation." This extension of the ego is worth more careful attention than we can give it here. When the egoistic will yields, personality does not become more sharply defined, but less so; more diffuse, it tends to lose itself in the general life, or general will. It is that which is strictly personal which gives to self its roughest sensations; the saint is hardly conscious that he is a distinct being, isolated from the world; he lives in the universal life; he and man, he and nature, he and God, are one. We find here again the *raison d'être* of this universal craving to yield one's self, to give up, to re-enter Nature's womb and live of its life. That state of confidence, trust, union with all things, following upon the achievement of moral unity, which we have found, more or less tersely expressed, in every conversion considered is the *Faith-state*.

The preceding pages have made apparent, we hope, the accessoriness of doctrinal beliefs in regeneration. The first part of the conversion-process ending in absolute self-surrender, needs have no dogmatic forerunners or accompaniments; the sense of sin and its natural feeling-consequences are all that must exist. From it flows out every experience of the "way down:" wretchedness, feeling of isolation, conviction of ina-

bility to realize the unity of purpose longed for and finally even despair. With the disappearance of every known sinful desire, a psychic revolution, harmonizing the motor tendencies, takes place and brings peace and joy. Neither is there any place for the necessity of doctrinal beliefs in this "positive phase." The only point at which doctrinal beliefs might condition the process is, then, the turning point; before and after the conversion-process all is determined by physiological laws, just as the round of feelings through which we pass during a bodily disturbance. We shall come back later on to this turning point.

We have seen also that various dogmatic beliefs supposed by Christian theology to be necessary to Salvation, suddenly, on the advent of the faith-state, acquire a character of certainty specifically distinct from the one they enjoyed previously. These dogmas, we have noticed, were in some cases believed in before conversion; in others, they were disbelieved or ignored. Whichever of them happened to be held on satisfactory rational grounds, or suggested to the mind by the experience undergone at conversion, as, for instance, in Mrs. Emerson's case, or yet any religious belief accepted on the authority of tradition as essential to conversion, assumed during the regenerating crisis a new reality, and became an object of Faith. In this new state, discussion is no more possible, because, inasmuch as the ground of assurance is not rational, argumentation is irrelevant. The seminary student expresses this with pleasing ingenuousness: "Strange to say, the arguments seemed not to enter into my thinking. There were no appropriate faculty and capacity for them in me. They stood apart from me. I could take the logical standpoint and could see that they were quite convincing, and yet my inward peace of belief was in no way disturbed." "Conviction" is, we see, a derived product, a mere casual off-shoot of the faith-state, having in itself no necessary worth. It is consequently a gross error to imagine that the chief practical value of the faith-state is its power to stamp with the seal of reality certain theological conceptions. On the contrary, its value lies solely in the fact that it is the psychic correlate of a biological growth reducing contending desires to one direction; a growth which expresses itself in new affective states and new reactions; in larger, nobler, more Christ-like activities. The strongest pillar of Christian "orthodoxy" rests not on rational arguments, but on such experiences as those we have quoted. The men who have contributed most during the last centuries to keep together the Christian system have derived their assurance and the ardor with which they forced it upon

the world from a conversion-experience. When biblical criticism, when historical and natural science, when psychology threatens the antique structure, it is in the regenerating power wielded by Christianity that the shaken believer finds shelter and rest. *The ground of this specific assurance in religious dogmas is, then, an affective experience.* Finney, for instance, feels a peculiar emotional disturbance, that he likens to a wave of electricity going through and through him; immediately this sensation, seeking for an adequate cause, connects itself with the idea of the Holy Spirit and the related doctrines. His phraseology is worth quoting:

"I instantly seized hold of this with my heart. I had intellectually believed the Bible before, but never had the truth been in my mind that faith was a voluntary trust instead of an intellectual state. I was as conscious as I was of my existence of trusting at that moment in God's veracity." Speaking of Bible promises he says: "They did not seem to fall so much into my intellect as into my heart." St. Paul's conversion did not rest on speculations, but on affective experiences. Luther suddenly finds himself at peace, relieved from the load of sin, which no amount of good works had been able to purge away, and then the scheme of salvation by faith, together with the related doctrines, becomes for him an unshakable reality. *Z.* did not believe in the divinity of Christ; but when the wonderful transformation came to pass, the divinity of Jesus appeared to him as sure and evident as conversion itself. *I.*, after having under pressure of the voice of conscience confessed to a man the wrong he had done him, declares, "I found a deeper peace and a greater gladness than I ever had before. *It confirmed my faith in the reality of God's Word, Christ's Work,* and my own conversion." Every conversion could furnish illustrations similar to these. In these cases certain conceptions are associated with an actual affective experience in the relation of cause to effect. The objects of Faith may even be preposterous; the affective stream will float them along and invest them with its unshakable certitude. The more startling the affective experience, the less explicable it seems, the easier it is to make it the carrier of unsubstantiated notions. The unwarranted support given to theological conceptions by the affective life is due to nothing else than to the universal and unavoidable proneness to connecting things as cause and effect for the only reason that they are together, or follow upon each other, in the mind. I fell once into a controversy with a very earnest and good man concerning the atonement as understood by a narrow church. As he was cornered by arguments pointing to the irrationality and immorality of the

doctrine, he suddenly ceased arguing and exclaimed: "It may appear so, but I cannot doubt it; *I have experienced it.*" He had experienced not only a change of heart, but also the transcendent doctrine of the atonement! Many of the most deeply rooted superstitions arise from similar accidental associations between sensations or emotions and ideas.

It is not in the province of this essay to consider in its general aspects the great question of the relation of feeling and sensation to intellect. But since our subject leads us to it, we shall subjoin some facts taken from a different sphere, showing in a striking manner how the feeling of reality belonging to a sensation or to an emotion is transferred to an intellectual concept.

In certain forms of insanity characterized by perturbations in the somatic or specific sensations, explanations of a most irrational sort are entertained and partake in the reality-timbre of the unfamiliar feelings they are meant to account for. A general paretic[1] suffering from heart trouble imagined that some invisible being was pumping wind into him. The loudness of the heart beats and murmurs had given rise to the delusion. More striking is the case of a young girl suffering from mysophobia.[1] She was troubled by an imaginary inability to keep her hands clean; she would be washing them every minute. When questioned about her general condition, she would complain of the uneasiness that her dirty hands gave her. One day some gentlemen attempted to prove to her that she was mistaken. "When did you wash your hands last?"—About two minutes ago.—What have you been doing since then?—Reading the newspaper. (She was holding it in her hands.)—Is your newspaper dirty?—After examination, the answer was, "No."—You have done nothing else since you washed?—No.—Then your hands cannot be dirty! Her hands were examined by the persons present and declared perfectly clean. She gazed at them evidently perplexed, endeavoring in vain to find dirt-spots, and after a short silence, exclaimed impulsively: "*But I feel they are dirty.*" She also, as the seminary student, could take the logical standpoint, and see that the arguments were quite convincing. Against such a ground of belief as hers, intellectual considerations cannot avail. Who does not know by personal experience to what nonsensical ideas a mastering fear will give reality! When the danger is past, we laugh at our absurdity; but if the affective state continues, the belief, however irrational and groundless it may be, remains as an object of faith, *i. e.*, it participates in the sense of reality possessed

[1] Seen at the Worcester State Lunatic Asylum.

by the affective experience itself. The cold philosopher who ignores the mighty religious affective states, sneers at the superstitious Christian. He cannot understand how men of broad culture and good common sense can give assent to doctrines to him so preposterous. The mystery vanishes when the slavery of the intellect to the affections and sensations is fully realized.

Our theological systems and articles of faith are the body of justifications given to the various affective experiences of religious life, arranged and systematized, more or less conformably to the science and philosophy of the time, according to the degree of scientific spirit and knowledge of those who assumed the labor of codification. If the religious *experiences* of our day are essentially the same as those of the beginning of our era, the conceptual world has changed wondrously. Nevertheless we still keep the precious stone in the old unbecoming setting, for fear, they say, that the stone will crumble to pieces if transferred to a newer mounting, and we continue to assert that the old one is genuine gold, because the genuineness of the stone has been, and is being, repeatedly tested. Meanwhile, very many, and these among the best, are made to care little for the jewel on account of its repulsive setting.

4. JUSTIFICATION. The sudden revulsion of the affective state experienced in conversion is usually interpreted as due to the disappearance of the load of sin; it is taken by the subject as the warrant of his *justification* and of his *salvation*. If the pre-conversion struggle is caused by the strife between desires, some of which are identified with the individual will to live, and some looked upon as not belonging to the ego (the promptings of the Holy Spirit), it is but natural that when the last resistance of the selfish will gives way, when the will to sin (not the impulse) has surrendered, the sense of condemnation should forthwith disappear and make room for a consciousness of pardon, a sense of release.

Narrower daily experiences make this phenomenon one of the best known to every one: it is tension followed by relaxation; indecision culminating in resolution. In the Christian consciousness this phenomenon becomes especially interesting, first on account of its scope—it involves the whole reaction apparatus, the direction of the whole moral life, and affects every future action having a conscious moral bearing; and secondly, on account of the complication, the particular hues it receives from religious beliefs. If the subjective duality is conceived of as due to sin against an external Being, the cessation of the conflict is looked upon as the

result of God's pardon. In a great many cases of conversion we find this subjective experience expressed as God's *forgiveness*, as the application to the soul of Christ's *atoning sacrifice*, and then it becomes the ground of faith in the related doctrines. But in other, no less numerous, cases the experience, in spite of Christian education, does not assume the aspect of a relation between man and God. Many converts, as we have seen in the chapter on the sense of sin, do not use "pardon," "justification," or similar words; they only make mention of the sense of relief and of the joy which they experienced.

Let us see what information our material gives on this point.

Sometimes the obtained unification of consciousness is not immediately recognized as the goal striven for. *M.*, for instance, wrote: "It seemed as if Jesus himself had come into my body, and taken full possession of me. I did not know, though, that I was saved, as we call it now; but I knew God had had mercy upon me." The famous revivalist, Nettleton, relates that "not long after this an unusual calmness pervaded my soul, which I thought little of at first, except that I was freed from my awful convictions, and this sometimes grieved me, fearing that I had lost all conviction [of sinfulness]." But on hearing other Christians relate their experiences, he realized his conversion. Finney: ". . . . I found that my mind had become most wonderfully quiet and peaceful. I said to myself, 'What is this? I must have grieved the Holy Ghost entirely away. I have lost all my conviction. . . . Why!' thought I, 'I was never so far from being concerned about my own salvation in my life. . . .'" In his perplexity he goes as far as to question whether or not he has committed the unpardonable sin, and he endeavors to bring back the load of sin. "But take any view of it I would, I could not be anxious at all about my soul and about my spiritual state. The repose of my mind was unspeakably great. I never can describe it in words." The affective state prevented the reviving of the sense of sin. Likewise Hallock, although he had passed through the whole process of regeneration, remained for a while in ignorance of the fact that he had been "born again." He relates in his "Memoirs" more than one case similar to his own. Edwards wrote of the converts of the Northampton Revival: "There is wrought in them a holy repose of soul in God through Christ, and a sweet disposition to fear and love Him, ... and yet they have no imagination that they are now converted; it does not so much as come into their minds." That the actual experience of "salvation" should not be immediately identified with the

preconceived representation of it, is not surprising. The after-conversion state cannot be known in the pre-regeneration stage; the fancies nourished by the imagination concerning the condition of the "saved one," may help to mystify the subject when the experience is actually upon him.

But the greater number of converts realize immediately that the gates of the kingdom of heaven at which they have been knocking, have opened, and that now God pardons and receives them. Livingstone testifies that he had joy and peace in believing: "I was conscious that I had received the divine Redeemer in all His offices, as offered to sinners in His Word; that I had devoted myself, for time and eternity, to Him, and was no longer my own; and that I had actually become united to Him. I have never doubted of this transaction, through all the trials of faith, to this day." We might have quoted these lines as illustration of the carrying power of the faith-state. John Wesley takes the warming of his heart, and his new affective state generally, as a proof of God's pardon, ". . . and an assurance was given me that He had taken away my sins, even mine, and saved me from the law of sin and death." *K.*, an ex-saloon and gambling den keeper, expresses himself as follows: "I made a full surrender of everything, and God for Christ's sake set my captive soul free. The chains of hell were snapped and I was a free man in Christ Jesus. Hallelujah! . . . . My pen fails to describe the joy that thrilled my soul as I received the witness of my sins forgiven. . . ."

5. Joy. If the affliction of the person under "conviction" is often painted in the blackest hue, the joy that accompanies the advent of the faith-state frequently appears to be beyond description. Mrs. Emerson says, ". . . my heart seemed to overflow with sweet, adoring ecstasy." It is never altogether wanting and is almost always violent during the first hours or days that follow; afterwards it subsides gradually, and becomes a steady peace and satisfaction. . . . "Nothing but perfect love filled my heart to overflowing."—*K.* "I wept aloud with joy and love. . . . I was so filled with love that I could not sleep."—Finney. "At the close of this awful scene which struck horror through the whole family, she suddenly burst out in raptures of joy and praise."—From Nettleton. "For two or three weeks it seemed to me that I would never know again that sin was in the world. I was filled with joy; everything was bright and good."—*P.* "And in an instant there rose up in me such a sense of God's taking care of those who put their trust in him that for an hour all the world was crystalline, the heavens were lucid, and I

sprang to my feet and began to cry and laugh. . . ." —Henry Ward Beecher. "But oh! with what joy, joy unspeakable, even joy that was full of and big with glory, was my soul filled, when the weight of sin went off, ... an abiding sense of the pardoning love of God and a full assurance of faith broke in upon my disconsolate soul!"— Whitefield. "Thereupon I felt as if born again, and it seemed to me as though heavens' gates stood full open before me, and that I was joyfully entering therein."—Life of Luther, by Michelet. "In my anguish I cried with an helpless despairing heart to Christ, and as quick as a flash of lightning, a joy so great rushed upon me into my heart that I knew the witness to pardon had come. My tears of sorrow changed to joy, and I lay there praising God in such ecstasy of joy as only the soul who experiences it can realize."—*U.* "Indeed I cannot tell you whether I was 'in the body or out of the body,' but, O! the light came; it was too much for me. I cannot express how I felt. It was as if I had been in a dark dungeon and lifted into the light of the sun. I shouted and I sang praise unto Him who loved me and washed me from my sins. I was forced to retire into a secret place, for the tears did flow, and I did not wish my shopmates to see me, and yet I could not keep it a secret."—*A.* "I felt very unhappy for a day or two, then light was given me. I saw what Jesus had done and could do, and all at once I became so unreasonably happy, though I could not then tell why."—*V.* Note how the physiological state of *E.* gave him happiness, in spite of the belief that he was lost. He was supremely happy, and yet he knew that he was undone and that God could not help him, although He loved him. "All the time I was supremely happy; I felt like a little child before his father: I had done wrong, but my Father did not scold me, but loved me most wondrously. Still my doom was sealed. I was lost to a certainty. . . ." We have here thought in contradiction with a feeling-reality. Theology did not square with experience, yet its traditional power was enough to keep it standing. A similar contradiction is found in Finney's conversion.

This ecstatic condition gives to the convert the illusion that he perceives unutterable, divine truths; that the mysteries of life have become lucid. Contradictions are swallowed in the emotional flood, and the most preposterous theories may assume the value of absolute truth. Sleep and hypnotism give us abundant illustrations of the glory and perfection which we can see in ideas that are ludicrously silly when waking life puts them in connection with related association systems. The astounding credulity of the illuminated, of the

mystic, of the convert, finds a satisfactory explanation in the simplification of intellectual life, in the reduction of associations to certain lines, as it happens when emotion concentrates attention, or in peculiar physiological states, in normal and hypnotic sleep, for instance. In these particular circumstances the ideas present in the mind are put into relation, but with few others; analysis, discrimination, comparison, are roughly performed, and thus few or no contradicting ideas are called up. Hence, whatever is in the mind has a good chance of not being negated. The weakening of the sense of the ludicrous and of the critical power in sleep is due to a similar limitation of our mental activity. These considerations apply to every emotion, and account for their accidental antagonism to reason.

6. Appearance of Newness. A curious phenomenon is frequently met with at this stage of the conversion-crisis. An *appearance of newness* beautifies every object; it is as if the state of internal harmony was projected outwardly. Jonathan Edwards describes as follows his own experience: "The appearance of all things was altered; there seemed to be, as it were, a calm, beautiful appearance of divine glory in almost everything: God's excellency, His wisdom, His purity and love seemed to appear in everything: in the sun, moon and stars; in the clouds and blue sky; in the grass, flowers and trees; in the water and all nature, which used greatly to fix my mind." Mrs. Emerson had already been struck with the joyful appearance of the faces in the meeting in which she was converted. The following day she repaired to school: "Here the alteration appeared more evident than in my own heart. Every countenance appeared inexpressibly beautiful. . . . I inquired with myself whether this happy, delightful place could be the same in which I had lately passed so many dark, dreary hours of despair and horror." A few more illustrations will not be useless: "When I arose the storm had ceased and the sun was shining. I was in a new world! Such beauty and glory in nature I never saw before! . . ."—The Rev. Mr. Peck. "But I have a fresh recollection that when I went in the morning . . . . into the field to work, the glory of God appeared in all His visible creation. I well remember we reaped oats, and how every straw and head of the oats seemed, as it were, arrayed in a kind of rainbow glory, or to glow, if I may so express it, in the glory of God."—The Rev. Mr. Hallock. "Immediately after conversion I felt somewhat like a stranger in a strange country; everything seemed new to me."—*F.* "I felt and knew I was a different man. It seemed as if the birds sang

sweeter, the sky bluer. Everything about me praised God, and a sweet sense of His presence was with me." Some speak of "a divine countenance," of "the glory of God."—*N.* This sense of freshness and of beauty is frequently observed after strong emotional disturbances, and also in certain diseases which come to a sudden turning-point. The youth who has sung for the first time his love-tale to his lady and receives the assurance of requited love, the afflicted one who has walked through a dark passage and suddenly comes to the light, may be filled with a sense of newness which he cannot help "seeing" and "hearing."

We might rest content with the explanation that we have to do with an emotional delusion in which the affective state colors external sense-impressions. Beecher was but partly carried away by his subjective state; and consequently the perception of external reality jarred upon his inner felicity: "I shall never forget the feelings with which I walked forth that May morning. . . . . The singing of the birds in the woods—for I roamed in the woods—was cacophonious to the sweet music of my thoughts; and there were no forms in the universe which seemed to me graceful enough to represent the Being, a conception of whose character had just dawned upon my mind. . . ." But we can perhaps make another suggestion, in this wise: The conversion crisis may be supposed to have for physiological counterpart a redistribution of energy involving general modification of the association paths; or an alteration of rhythms, changing the nervous regimen. It is natural enough to admit that to a psychic turmoil so intense as that of conversion corresponds a no less considerable physiological commotion settling in a new arrangement of the motor mechanism.

The sense of newness often continues for a considerable time after the recovery of peace.

7. The Rôle of the Will. Instead of gathering now the information to be found in the records of conversion on the rôle of the will in regeneration, we shall pass to the second part of our essay and introduce in the section on "The Doctrine of the Grace of God, Will and Determinism," what should be properly placed here. This arrangement has the advantage of bringing the statement of the facts nearer to their discussion.

Part II.

How do Christian doctrines agree with the facts brought out in the preceding psychological analysis of conversion? Are the church dogmas concerning salvation, faith, justification, grace, predestination, in agreement with them? It will not be without psychological interest, still less without practical value, to place face to face theories and realities. The colossal influence which Christian theology has wielded during nineteen centuries, taken together with the actual crumbling down of the doctrinal pillars of Christian Orthodoxy, pointing to a great and not far distant reformation, invest with momentous interest any serious endeavor to restate religious truths on an empirical basis.

We have seen in a preliminary chapter on the Religious Motive that the clearer the religious consciousness, the more exclusively is theology a scheme of salvation; all other matters tend to fall out into the domain of general philosophy. Provided the word "salvation" is properly understood, it is correct to say that Christ concerned himself with nothing else than the salvation of man; and that Christian creeds are but a metaphysics of the ways and means of regeneration.

One of the mysteries of the world to the looker-on who ignores, either from lack of personal experience or from lack of observation, the specific renovating power of Religion—and these blind lookers-on constitute a large part of civilized society—is the inconceivable amount of energy apparently wasted by humanity in theological discussions. But the meanest religious wrangle assumes an august aspect to the eyes of him who sees in the dispute bearings on man's eternal salvation. Much rather is there a mystery in the deadly earnestness of mankind in search of a new-birth: it is the mystery of evolutionary forces driving humanity to goals it understands not. The lucubration of man's brains may be fantastic—the mind is a wind-mill that may grind trash, but it never turns without wind. Salvation (new-birth) is known as a need, and it is known as an experience. Its reality, looked upon from the point of view of evolution, is a redistribution of energies made necessary by the introduction of new functions; it is a specific transformation similar perhaps to the variations constituting a new species in the animal world.

Since the facts of salvation are the only objects of a practical theology (the etymological meaning of the word matters little), let us, at least cursorily, pass in review and compare with the results of our analysis some of the core-doctrines of the Christian church.

1. THE DOCTRINE OF JUSTIFICATION. The Protestant creeds agree in defining justification as the judicial act of God by which He pardons all the sins of the sinner in virtue of the sacrifice of Jesus Christ. Justification does not make man inherently righteous, it is a simple *imputation* of the righteousness of Christ, by which man is *accounted* righteous. The penalty incurred has been paid by Christ, therefore man is justified. It is an external judicial act absolutely independent of man's merits. The Gallican profession of faith says for instance: "*Car les uns ne sont point meilleurs que les autres jusqu' à ce que Dieu les discerne, selon son conseil immuable qu'il a determiné en Jesus Christ devant la crëation du monde.*" And the Thirty-nine Articles of the church of England declare that, "We are accounted righteous before God, only for the merit of our Lord and Saviour Jesus Christ by faith, and not for our own works and deservings." The other Protestant creeds are on this point in perfect agreement with each other and stand in opposition to the Roman church, which holds that justification is not a mere forensic act, that it is not only *imputed*, but also *communicated* through grace. Justification, according to that church, is at the same time remission of sin and the infusion of righteousness. The consequences attributed to justification by Protestant theologians are peace, reconciliation with God, the restoration of intercourse between Him and the sinner, and a title to eternal life.

Thereupon we remark that converts *feel* justified or pardoned—for, although theologically these two terms have a different connotation, experientially they are one,—as the doctrine affirms, not after the performance of good works, but after a crisis in which they appear to themselves to be passive. St. Augustine cries out: "And thou, O Lord, how long? how long?" Not that they desire not, but that their will is not effective. They have the consciousness that not they, but God's grace performed the transformation. Hence that which brings the sense of justification is neither their merit, since it is when they see themselves in the darkest colors, without any goodness or any hope in their own strength, that the sense of pardon comes; neither their good works, since the crisis is completely independent of any outward activity. Thus far the Protestant doctrine corresponds to experience.

The statement that the sinner is "accepted as just, though not just," expresses perfectly the state of consciousness of the convert. He cannot feel condemned now that the will to sin is destroyed, and yet he is conscious of not having attained to perfect holy living. In considering peace and the feeling of reconciliation with God as consequences of the act of jus-

tification, theology reverses the psychological process: for, as we have seen, man believes himself pardoned and justified, *because* he finds himself released from the oppression of sin. It will be objected by some that because the convert knows that he is pardoned upon the recovery of peace only, just as the prisoner infers his acquittal from being set at liberty, it does not follow that the judicial act of justification has not preceded the discharge of the prisoner. It is clearly out of such an anthropomorphic conception that the Christian doctrines have evolved. Until the conception changes, this part of the doctrine will remain in its present form. The Roman doctrine looking upon justification as the covering of sin through an infusion of divine grace, is nearer to the facts. It identifies in some measure justification with regeneration.

The Reformers, and particularly Luther, laid great stress on the *assurance* of salvation. Similarly a large part of the Christian church of to-day expects and requires of every one *an experience of salvation.*

In the primitive church the reception of the Holy Ghost seemed to have been a necessary accompaniment of conversion; what that meant exactly may not be clear, but it was very likely affective manifestations of the faith-state, of like nature with those we have met in the preceding analysis. (See Finney's Conversion, Appendix and pp. 324 and 330.) The particular forms in which affective states dress themselves, are functions of the intellectual atmosphere of the time.[1]

The custom of Spiritualist mediums of speaking in a particular jargon, the same in the same country and at the same period, is also in point here.

2. The Doctrine of Faith. Justification is conditioned on the side of man by *faith.* That "we are justified by faith alone, without any manner of virtue or goodness of our own," is the common statement of all the Protestant creeds. The Pauline doctrine partially lost sight of after the first

[1] The influence of the "milieu" on our mental forms is strikingly illustrated in insanity. The ordinary correspondent in mental disorders, is some one of the personages, or powers, which occupy popular attention. Up to the modern era it was the devil, incubus, angels. Epileptics were demoniacs; hysteric women held converse with evil spirits or entered into mystical union with Christ. All that is past in our advanced communities: electricity and magnetism, oddly enough, have dispossessed the satanic family of a field so well suited to their mischief-making propensities. Go to certain insane asylums to-day and you will hear women and men tell you of "electrical" possession and impregnation, of being troubled by magnetic currents constantly passing through the room, etc.; but you may not hear a single word about the doings of the devil.

centuries of our era, was reaffirmed by the Reformers as the cardinal principle of Christian life, and since then the numberless Protestant denominations rally around the motto, "Salvation by Faith." Even the Unitarians subscribe to this affirmation (see pp. 319-320). It is the central doctrine of modern Christianity, the only one which continues to prosper while the others decline.

If there is agreement concerning the necessity of an experience or state called faith, there is a remarkable diversity of opinion as to the meaning of the word faith. Psychological analysis is sorely needed here. Some definitions of faith do not cover at all the same ground, some overlap partially, very few coincide. The author of the Epistle to the Hebrews wrote: "Faith is the substance of things hoped for, the evidence of things not seen." Anselm includes the will: "The mere idea does not make faith, although this cannot exist without an object; in order to true faith the right tendency of the will must be added, which grace imparts." Some make it synonymous with intellectual assent, as Thomas Aquinas, who said: "Faith is an act of the intellect assenting to divine truth, in virtue of the operation of the Spirit of God upon the will. Hodge in his "Systematic Theology," Vol. III, page 60, defines faith as "a conviction of truth founded on testimony," and quotes Hase: "*Unmittelbar Führwahrnehmen, ohne Vermittelung eines Schlussbeweises durch Neigung und Bedürfniss.*" J. E. Edman neglects the mental assent and makes it an affective fact, "*Bewusstsein der Versöhnung mit Gott.*" These two elements are frequently united, for instance in the Heidelberg catechism. Its answer to the question, "What is faith?" is: "It is not merely a certain knowledge whereby I receive as true all that God has revealed to us in His Word, but also a cordial trust which the Holy Ghost works in me by the gospel." The creed of the Reformed Episcopal Church of America declares that "the faith which brings justification is simply the reliance or dependence on Christ which accepts him as the sacrifice for his sins, and as our righteousness." The Roman Catholic church distinguished at the Council of Trent between a *dead faith*, which is simply acceptance of what God has revealed, or the church commanded to be believed, and which can exist even in sinners, and a *living faith*, which expresses itself in works of charity. Faith, according to the Roman church, is only the beginning of salvation, the root of all justification. McClintock and Strong's Cyclopædia sums up this dogmatic medley as follows: "Faith, as used in the New Testament, includes three elements, each and all necessary to the full meaning of the word, while one

or another of them may become prominent according to the connection, viz., (1) full intellectual acceptance of the revelation of salvation; (2) adherence to the truth and to the person of Christ thus accepted; (3) absolute and exclusive trust in the redeeming work of Christ for salvation. In no one of the writers of the New Testament is any of these three elements wanting."

These definitions of Faith include two disparate elements: (1) a specific affective state; (2) certain intellectual beliefs. We have given reasons for refusing to designate these two elements by one name and have denominated the first only as Faith; the other we have found to be a non-essential and accidental accompaniment of the faith-state. We have seen in Part I, pp. 337 ff, that deliverance from sin and the joy of salvation invariably followed upon the advent of the faith-state and were independent of the doctrinal beliefs supposed necessary to salvation; and furthermore that the characteristic affective state marking the passage from the "way-down" to the "way-up" need not even have a specific object in the person of Christ. Faith is a state of internal harmony. The disposition to trust and confidence is a natural consequence of it. We saw how the convert projects outwardly his feeling of happiness and newness §6. Appearance of Newness). The persons whom he connects with his blessed transformation will, in like manner, be the especial subjects of the objectivation of his inner felicity and loveliness. Saving faith *generates* trust in this doctrine or in that person; *it is not trust.*

Now concerning the rôle of faith in the Christian system. The Augsburg Confession, Article IV, says: "Men are justified freely for Christ's sake through faith when they believe that they are received into favor, and their sins are remitted for Christ's sake; this faith doth God impute for righteousness upon Him." We give elsewhere the statement of the Thirty-nine Articles on this point. The Westminster Confession declares that "faith, ... resting on Christ and His righteousness, is the alone instrument of justification." The Methodist Articles embody the experience of John Wesley. In his sermon on justification are these words: "We mean this much, that it [faith] is the only thing without which no one is justified; the only thing that is immediately, indispensably, absolutely requisite in order to pardon. As, on the one hand, though a man should have everything else, without faith yet he cannot be justified; so, on the other, though he be supposed to want everything else, yet if he hath faith he cannot but be justified." Every one of the other Protestant creeds expresses the

same idea in nearly the same words. There is, then, general agreement on this point. But if faith is looked upon as a pre-requisite of justification and salvation, it is not represented as a procuring cause of salvation; it is but the *instrument*, or the *means of apprehending* grace and remission of sins, as the Augsburg Confession has it. Not only are good works not a ground of justification, faith itself is not; for it is not of man's production, but an effect of God's grace. Man is saved by the "object of faith," *i. e.*, by the merits of Christ, the Redeemer.

Orthodox Protestant theology is throughout consistent in its three fundamental declarations: (1) that nothing is able to save man except the death of Jesus Christ, the Son of God, (2) that without faith there is no salvation, (3) that faith is nevertheless only the instrument of salvation, or according to others, merely the means of apprehending it. Furthermore, as there is no true faith possible without salvation, it follows that "faith" is the work of God in man, performed when the merits of Christ are imputed to the sinner. *It can exist but as a consequence of the work of Christ*, a work in itself completely external to man. In order to retain the doctrine of the Atonement, the church *must* see in faith a gift of God; for otherwise man attains faith of himself, and consequently saves himself, since it is admitted that faith involves union with God. Logically, then, to maintain the Christian scheme it is necessary to affirm that the sovereign will of God, determined by man's will, according to the Pelagians, or by His own lordly pleasure without regard to merits, according to orthodoxy, imputes to man Christ's righteousness; and that faith is granted thereupon, or therewith. In that way a necessary concession is made to reality without prejudice to the Atonement: experience and metaphysical speculations are made to walk hand in hand.

It is sufficient for its condemnation that the doctrine be stated. Here again theology has been led astray by a crass anthropomorphism, assimilating God to a Judge.

The analysis of conversion shows that the faith-state, like any other psychic state, follows upon other processes of a like nature. Unless we give up continuity and with it all possibility of the world being a rational moral order, we must conceive of faith as supervening upon specific and always identical psychic phenomena. The supposition that a particular portion — if we may use that term — of our psychic life is severed from subjective causal antecedents of a like nature with itself, and is brought about by an act of God following upon a decision determined by Christ's sacrifice — the subject's knowledge or ignorance of it does not affect the ques-

tion, — belongs to the mythology of a by-gone age. We have seen in previous chapters what are the forerunning links of the process; the facts make plain that salvation (deliverance from moral duality and sin) is a concomitant of faith, and that faith necessarily follows upon the sin-pain and self-surrender, according to a law of continuity of the same nature as the one determining the succession of our thoughts and feelings. There is no more reason for positing a superhuman interposition in the succession of the phenomena of conversion (sin-pain, self-surrender, unity, joy, disappearance or weakening of certain impulses and desires) than in the more ordinary changes — be they sudden or gradual — of our affective life, as in the cessation of "moral," "mental," or "physical" pain. The alterations of personality, recently investigated, are no less wonderful than the conversion-experiences.

The compelling power of experience tends to let the mythical side of the doctrine fall into oblivion. Even men considered as firmly orthodox drift unconsciously into the new view. On every side we hear that neither intellectual reception of the truths of Christianity, nor baptism, nor church membership, nor participation in the Lord's supper, nor good works will secure salvation, but only faith in Jesus Christ. In a prospectus of the four Bible schools founded by the evangelist, D. L. Moody, we find the following passage; it would most probably receive the endorsement of the Protestant churches in general:

> Some may query what in the view of these schools constitutes a Christian. And this is easily answered without the use of a single theological term. Becoming a Christian is on our part simply a transfer of personal allegiance. When, for instance, a girl in Northfield Seminary is said to become a Christian, it is not meant that . . . . . she has been brought to subscribe her assent to the articles of the creed, however true the creed may be. But it is meant that she has freely given her personal confidence to the most trustworthy Being who ever appeared among men. . . . His Spirit makes upon her spirit a wholly new impression of the divine character, and this begins a radical change in her own, a change that grows marked directly in proportion to the intimacy of the relation maintained by the disciple with the Master.

It would be easy to cite pages upon pages from the literature of aggressive Christian denominations showing that, in spite of orthodoxy, a large part of the church is practically unmindful of the atonement transaction, and considers faith as the *natural and necessary* consequence of well-known subjective antecedents.

On the vital point of the doctrine the church and the facts are in full agreement: *both declare that without faith*

there is no possible regeneration. We should like to draw the attention of the reader to a weighty consequence of this principle. The conviction that between the morally righteous man and the true disciple of Christ there is a specific difference, is to-day deeper than ever. Many will remember the sense of wounded pride, of irritated mortification at being made to understand by some plain, empty-headed fellow that, despite their good desires and worthy conduct, they needed conversion ; that the kingdom of heaven did not belong to such as they ; that between him and them there was the gulf separating the saved from the lost. Such talk smacks of arrogance and conceit. Yet the man may have been right ; at any rate he was making a distinction which psychology as well as theology recognizes, *i. e.*, that faith (the particular affective state we have met with in conversion) creates a specific difference between men. Jesus Christ was fully conscious of this differentia when He told good Nicodemus that he must be born again. St. Paul affirmed the same truth when he wrote, " Therefore if any man be in Christ, he is a new creature, old things are passed away; behold, all things are become new."—II Cor. v: 17. We discern the same consciousness in Gautama, and in the saintly figures which stand out luminously in the history of the Christian church. We may scorn the Salvation Army girl who testifies to the same internal life, and asks us whether we are saved ; but we cannot make light, in a matter of experience of this sort, of the unanimous declaration of men to whom we are compelled to ascribe exquisite delicacy of moral and religious feeling. Roman Catholics, Calvinists, Unitarians,—all proclaim the same doctrine. As specimens of Christian opinion, we quote the following from two sources very different, if the intellectual status of the authors be considered :

> The sum of our doctrine, then, on this vitally important subject is this: Regeneration, in its internal nature and process, includes three things: First, the receiving the divine life into our inmost being through those capacities that open inward towards God and the spirit-world,—the divine life imparted by the Holy Spirit that ever breathes through the heart of humanity. Secondly, moved by this divine and attractive force, our natural powers, intellectual, affectional and active, incline towards God, and are drawn into His service. Thirdly, all corrupt instincts, whether we acquired them ourselves or received them as the foul inheritance of the past, constituting the Adam of consciousness, are expelled. This is the old man, which is put off as the new man is unfolded from within.[1]

[1] " Regeneration," by Edmund H. Sears, p. 140. Published by American Unitarian Association, 1893.

It [faith] consists in a real change from nature to grace as well as by grace. The term of creation is real: the form introduced in the new creature is as real as the form introduced by creation into any being. . . . The first principle of the new creature is faith. . . . . It is not if any man change his opinion from gentilism to Christianity, he is a new creature; but if any man be in Christ by a vital participation from union with Him. . . . . It [morality] removes not the body of death. It is a cutting away the outward luxuriances, not the inward root. It removes the stench and putrefaction, not the death; an embalmed carcass is as much dead as a putrefied one, though not so loathsome. . . .'"[1]

Christian life differs from moral life in some such way as love differs from affection and friendship.

The inner condition of the "New Man" is thoroughly different from that of the self-righteous man: the tendency making for ordinary morality, *i. e.*, the affirmation of the individual will in an effort to live righteously, is in direct opposition to the faith-state. It is, as we have seen, when self-surrender is complete, when the will to satisfy the law has seen its impotency and laid down its arms, that the new creature comes to birth. No better illustration of this specific difference exists, to our knowledge, than the case of John Wesley, recorded above, pp. 339 and 340. He acknowledged between his state of moral righteousness, in which he exclaims: "If it be said that I have faith (for many such things have I heard, from many miserable comforters), I answer, so have the devils—a sort of faith; but still they are strangers to the covenant of promise. . . . I want that faith which St. Paul recommends to all the world, especially in his epistle to the Romans: that faith which enables everyone that hath it to cry out, 'I live not, but Christ liveth in me'" (Wesley's Journal)—and his after-conversion condition, a radical difference, *faith*, the Christian differentia.

A. expresses a similar experience: "I attended Sunday school from a child up until I was twenty years of age. . . At twenty-one I became a member of the R. P. Church. I might say with Paul, I was 'a Pharisee of the Pharisees.' Hitherto I had lived a consistent and, to all appearances, an unblamable life, nevertheless I was conscious of wrong within. . . . . I felt the need of the 'one thing needful,'" etc. (Appendix). The facts justify the church in its claim that the true Christian possesses a life in which the merely moral man has no share. There *is* a biological reality behind the belief that a special relation binds him to the Creator; when he calls himself "saved," "elect," "partaker in

[1] From the writings of the Rev. Stephen Charnock, D. D. (a non-Conformist divine of the middle of the 18th century). Published by the Presbyterian Board of Publication, 1840.

the divine promises," "beneficiary of the covenant of grace," "a new creature," etc., he expresses in various symbolic forms his specific subjective state. We cannot suppose that church members are all Christians in this specific sense; a large proportion of them, it seems, never rise to the faith-state. Their meaningless assent to the creed and their love of virtue are their only title to church membership. They belong to the great mass of outsiders; for, just as many men live affectionately and respectably with a wife without loving her, so most men live useful and correct lives outside the realm of faith.

All this said, and possibly agreed upon, what is the practical value of faith? There are those who look upon love as a morbid phenomenon, and want to see it replaced by simple affection. Is faith worthy of the panegyrics lavished upon it? Is it indeed a higher life, a divine life; or is it but a freak of nature, a phenomenon bordering on insanity, which, instead of being sought after, should be suppressed? The facts of regeneration give, it seems to us, an imperative answer to this query.

3. Will, Determinism and the Doctrine of the Grace of God.

What is the rôle played by the will in conversion?

We shall conform in this section to the prevalent opinion and use the word "Will" to designate a supposed or real self-determined power of choice, independent of, and of a different nature from, desires; having in itself the ability, by some not understood means, to cause a stronger desire to be overcome by a weaker one, and thus to save our actions from mechanical necessity.

However paradoxical it may appear to one familiar with the indignant outcry raised by the church against scientific determinism, modern empirical science cannot claim for itself the discovery of the illusory nature of free-will; that honor—if it is one—must be left to the Christian church, unless Buddhism should claim it. Long before science had reached determinism, experience had led the church to formulate as a fundamental principle of the psychology of the scheme of salvation the utter impotency of the will. To the question, what can men do to obtain salvation? the Christian church has but one consistent answer: Nothing; it is the fruit of the Grace of God, which worketh according to its own good pleasure. Although the doctrine affirms that of our own will we cannot believe, that faith is a gift of God, not given according to merit or desire, in practice — and this is but one of the many inconsistencies into which we are forced

when we pass from theory to life—the ministers of the church repeat the words, "Whosoever will may come," and urge men to "believe."

Calvin, following St. Augustine, declares in the Gallican Profession of Faith: "*Et bien qu'il y ait une volonté par laquelle il est incité à faire ceci ou cela, toutefois elle est du tout captive sous péché, en sorte qu'il n'a nulle liberté à bien, que celle que Dieu lui donne.*" Furthermore the divine grace is given irrespective of merit: "*Car les uns ne sont point meilleurs que les autres, jusqu'à ce que Dieu les discerne selon son conseil immuable qu'il a déterminé en Jésus Christ devant la création du monde.*" The Augsburg and the Helvetic confessions affirm the same two points: Inability of the will to acquire faith and the good pleasure of God as the only determining cause of the application of His Grace. The *Confession de Foi des Eglises Réformées wallonnes et flamandes*, and the Scotch confession do but repeat the Gallican Articles on Free-will and Election with less emphasis. The former says, "*Par quoi nous rejetons tout ce qu'on enseigne du franc arbitre de l'homme, parcequ'il n'est que serf de péché et ne peut aucune chose, s'il ne lui est donné du ciel. . . . .*" The Thirty-nine Articles of the Church of England do not substantially differ from the preceding: "The condition of man after the fall of Adam is such that he cannot turn and prepare himself by his own natural strength and good works, to faith, and calling upon God." "We are accounted righteous before God, only for the merit of our Lord and Saviour Jesus Christ by faith and not for our own deservings." "Predestination to life is the everlasting purpose of God, whereby (before the foundation of the world was laid) He hath constantly decreed by His counsel secret to us, to deliver from curse and damnation those whom He hath chosen in Christ out of mankind, and to bring them by Christ to everlasting salvation, as vessels made to honor." The Westminster Confession is thoroughly Calvinistic. The Methodist Articles and the creed of the Reformed Episcopal Church of America, are identical with the Thirty-nine Articles on the subjects of Free-will and Justification. The great creeds of the Protestant churches deny to man not only the natural possession of the instruments of salvation, but even the power to appropriate them to himself when they are offered.[1]

The determinism they proclaim is *one-sided*, inasmuch as

[1] It is worthy of note that the greatest thinkers of the church, St. Augustine, Calvin, Edwards, and others, have found these conclusions logically necessary.

man is granted the power to do evil of himself, but not that of efficaciously willing good. A theory so persistently put forth for so many centuries, and still holding the field, must have a deep experiential root. That this doctrine is rarely heard of in modern pulpits does not warrant the inference that a systematically elaborated free-will doctrine has been put in its place; on the contrary, the weight of modern psychology goes to make determinism universal; if it is left in the background, it is because our intensely practical age ignores theories.

The experience on which the one-sided determinism of the church rests is what we have called "self-surrender." We have seen that before the advent of peace and the assurance of salvation, the convert experiences the futility of his own efforts: "self-righteousness" is found to work but greater anxiety and deeper dissatisfaction. Luther in his cell, endangering his life by mortifications in order to conquer the evil that was in him, with no other effect than increased moral wretchedness, is a classical example of the impotency of the will in the work of salvation. It is here, in the sense of sin, in the dissatisfaction caused by moral dualism, that we must seek for the psychological root of penance, maceration and asceticism in general. When the body is looked upon as the cause of the pain of sin, any violence to the flesh that may be supposed to subdue its appetites is counted a step towards heaven.

One of the deepest impressions left by the perusal of the conversions we have seen, is the *passivity* of the subjects. They are lookers-on; they attend as spectators the drama that is being played in their consciousness, just as a patient observes and watches for the development of his disease. But before assuming a quiescent attitude, they pass through a period of self-affirmation, of desperate efforts to bring about the desired salvation, — efforts which are but muscular tensions. When their ineffectiveness is recognized, the failure of the will is acknowledged, and resignation to God's good pleasure takes the place of confidence in self.

This quiescent attitude is striking in many of the cases we have dissected. Hadley wrote, "How I wondered if I would be saved!" *I.*: "For about three years I maintained a fairly moral condition by constant struggles and self-efforts. . . . . There was not then, and I knew it, any real inner life, no spiritual joy, no love to the Master. It was a painful forcing to religious duty, and not a spontaneous following of the Divine Voice." Of a later period he says, "I did try at intervals to stop drink by self-resolutions, promises, pledges, only to fall back weaker and deeper down

than before. . . . At last I abandoned all efforts and let the tide rush as it would, indifferent to everything human or divine. . . . . When I got utterly hopeless, helpless, in the darkest despair. . . . ." then salvation came. He concludes his narration with these words: "He [Jesus] delivers me from self-effort, struggles, unrest and self-condemnation; it is simply a life of growth by constant trust."[1]

G. and O. had repeatedly signed abstinence pledges, and had made desperate, but vain, efforts to keep them. It was only when all hope of succeeding by their own strength had gone that redemption came. *J.* found that a series of reformations and relapses "had a very hardening effect." "I saw clearly that I had placed myself where human help could do me no good. I had lost my will-power. . . ." St. Augustine, soul-sick, rolled and turned in his chains "*till they were wholly broken*;" he cried within himself, "*Be it done now, be it done now.*" Deliverance, having refused to obey the summons of the will, falls upon the grieved soul at the time of the intensest realization of helplessness, when relaxation has superseded tension; often the unexpectedness of relief causes the convert to doubt his salvation, although he has already obtained it (see p. 350). Sometimes there is a period of revolt, as in the case of Nettleton, who felt he had done all he could, and thought it unjust of God not to "receive" him. He learned later during his missionary career that 'the Spirit of God moves when and where It wills, and does not come at the call of man.' He relates the following incident, which took place at a revival meeting in a private house: "Very soon Emily returned exclaiming, 'O, I cannot go home, I dare not go. I shall lose my concern. What shall I do?' and threw herself down in a chair, her head on the table in the deepest agony. All at once she became silent, and gently raised her head with a placid countenance, and was heard to say in a mild tone of voice, 'O, I can submit, I can love Christ. How easy it is;

[1] The process of conversion offers to pedagogy incomparable illustrations of the power of sympathy, of trust, in the relation between teachers and pupils, and, generally, between men. If the cardinal principle of religious life is "*Salvation by Faith*," the fundamental principle of the ministers of education should be "*Growth by Sympathy*." Receptivity and suggestibility are proportional to the degree of trust, of self-surrender, of unconsciousness, to which the pupil is brought. Sympathy does not only make communication from teacher to scholar easier, but, better than that, it draws out, unfolds, liberates, potential life. The teacher who provokes resistance, criticism, disdain or indifference, should be banished from the school room; he can neither teach nor educate.

why did I not do it before!'" Colonel Gardiner and *M.* were converted in what appears to be a semi-sleep.

How could theology have affirmed the freedom of the will when it is found to be useless in this all-important matter of salvation? St. Augustine needed no other instruction than a conversion-experience to become the apostle of the "total depravity" and "predestination" doctrines.

Now, in spite of the impotency of his will, man is nevertheless rescued and made to enjoy the peace of pardon and the assurance of having been received into the Fatherly arms of God, and that suddenly, as by a miracle. A second before, a miserable convict dragging his chains after him; now free and filled with unutterable love! How is such a wonderful transformation to be explained? The doctrine of the "Grace of God" given freely without consideration of merits, is the answer of the church to that query; no better answer could have been given at the time of the formulation of the dogma. We may remark, by the way, that the same argument for the intervention of God's power can be made for any one of the bodily disorders, such as neuralgia, etc., in which sudden cessation of pain is of common occurrence.

Christianity is not the only religion preaching the blessedness of a surrendered life. The Stoics (some of them at least) sought salvation in the detachment from the changing fortunes of the outer world; they saw that inner unity was not to be attained by proud self-assertiveness, but by humble submission to the Ruling Powers. The Buddhist philosopher teaches at-one-ment with the world-spirit through the destruction of all carnal desires; he gives up desiring and lapses into passive contemplation. His efforts to fall in with the cosmos and be absorbed in it, correspond to the Christian struggle to let God's will rule in himself. In Schopenhauer's denial of the will to live, we find this self-surrender motive systematized. Buddhists, Christians, Stoics, however they may differ on other points, unite to affirm the necessity for man, in order to obtain his desire,—be it called Nirvana, salvation, happiness or otherwise, — to surrender, give up, renounce. They proclaim unanimously, from experience, the deceptive nature of the will to live. The cause of this universal renunciation—one of the most deeply significant phenomena of moral life—is, it seems to us, not so much the disappointments in the achieved as the disheartening experience of the failures of the will. There comes a time in the evolution of the moral life of every people at which the barrenness of the will-effort (or will-tension) is realized; then self-renunciation is introduced in the national religion as a cardinal principle. The essential difference between the

Buddhist and the Christian is that the latter does not only believe that the carnal man must die, but also that he dies to make room for a new individuality. The first suppresses the stream of life, the other changes its direction.

But why is it that man looks upon the descending current of the stream of life as *his*, while he considers the ascending one as *not his*? Why does he identify himself with the desires to be denied, the evil tendencies; while he ascribes to God the desires to be affirmed? The moral religions and philosophies are expressed from that standpoint. Hence they call for *self*-surrender, *self*-renunciation, *self*-annihilation. Why have they not included in the conception of the "self" both terms of the dualism and given man credit for the good as well as for the bad that is in him? Had they done this, they would have exhorted man, as the Concord Sage, to *self-affirmation* and *self-reliance*. Or, then, adopt the other alternative: deny him the good and the bad and look upon him as the stage on which life's drama is being played, as some of our ego-dissolving psychological schemes do? The explanation of this alienation of the higher motives from the self need not be sought for very far. Long before being acquainted with what we called later altruistic impulses, our consciousness was occupied with selfish motives. Primitive man and the child of civilized races are selfish individuals. To them life is but a pursuit after the satisfaction of egoistic desires, and consequently is known by the affirmation of the selfish will only. Later on altruistic instincts come to birth and introduce tendencies opposed to the feelings and desires which up to that time had made up the whole of our ego. Is it to be wondered at if we do not recognize these new comers as "ours," in the same sense as the primitive egoistic desires are felt to be ours? They come to us we know not whence, unexpected, uncalled for, and stand in antagonism to that which we have always called our ego; furthermore, at first they are hardly felt in themselves, but rather only as inhibitions of customary desires,—they do not show themselves openly, they betray their presence by the suppression of the satisfaction formerly derived from the affirmation of the selfish will to live. That man should have denied naturalization to such an evanescent alien was unavoidable. He cannot help considering himself as passive in the conversion crisis: he *receives* Jesus Christ; he *lets God take possession* of his being, he *yields*, he *surrenders*. Yet the very words "receive," "accept," "surrender," have a positive side; they can just as well be accompanied with that which constitutes effort. As a matter of fact, although, for the reason we have given and in accordance with the prev-

alent theology, the subject looks upon the sinful tendencies as belonging to his ego, he cannot avoid at times calling the upward impulses *his*, and then he expresses himself as *I.*: "By every conscious effort of my mind and will, I surrendered myself to the power of Jesus. . . ."

Impulses in two directions, both equally ours, because we feel them both, and equally independent of will-effort, is what analysis brings to light concerning the rôle of the will in conversion.

When regeneration is obtained, the desires of the egoistic will fade or disappear more or less completely, and a set of new impulses, bringing with them new emotions and feelings, occupy the foreground of consciousness. Gradually these new-comers acquire a familiar aspect, a home-tinge that makes the convert speak of them as his *new*, in opposition to his *old ego*.

The church denial of the ability of man to do good of himself means nothing more than the recognition of the inefficaciousness of the will-effort. It is here in agreement with the modern psychologists who see in the sense of effort merely the return sensations of muscle contractions.

The third and concluding part of the essay is to be published later. It is chiefly theoretical and speculative, being an attempt to point to the possible physiological correlates of the psychic facts analyzed in Part I. It includes a genetic theory of sin, of moral resistance, of consent, of self-surrender and of the faith-state, and ends with general considerations touching the physiological forces at play in religious life, and especially in conversion, and their bearing on some ethical and philosophical problems.

I take with pleasure this opportunity of acknowledging the indebtedness under which I stand to President G. Stanley Hall for the continued help, stimulation and inspiration received from him during the three years I have spent as student at Clark University.

I also tender my hearty thanks to Dr. E. C. Sanford for the assistance he always readily granted me and for suggestions concerning this essay, and also to a friend who patiently assisted me in the tedious work of revising my manuscript.

Appendix.

The concrete cases of conversion, which constitute the clearest portion of our observation material, were in part gathered from literature, biographies, memoirs of great revivalists and religious periodicals, and, in part received in answer to the questionnaire printed below,[1] or taken directly, in private interviews, from the mouth of the converts. In the following pages the reader will find a selection of typical and striking cases of sudden regeneration. During our early adolescence, circumstances, and later philosophical interest, have brought us in contact with the phase of life herein examined. We have frequented "revivals," mission meetings, Salvation Army exercises, etc., and thus have gained, in the atmosphere of such assemblies, a practical knowledge of the subject of our thesis, which has been to us an invaluable guiding light.

The questionnaire was sent to persons who were thought to have "experienced religion," to mission leaders and pastors, and through them to a large class which we could not have reached directly. It was moreover published in *The Presbyterian* of Philadelphia, in *The Christian* of London, and in *The Outlook*. It was to be expected that conversion tales would be cut more or less after the classical pattern furnished by such famous conversions as those of St. Augustine, Bunyan, and Wesley. As a matter of fact a small percentage of the answers received were made up of the phraseology current in revivals and mission rooms, and smacked so strongly of religious cant, and so little of personal experience, that they had to be rejected; most of them gave internal evidence of earnest effort to describe accurately an experience to which a momentous significance was assigned.

One is at first astonished at the uniformity of the process described by the subjects of conversion. At a distance of more than a thousand years, among circumstances varying widely as to nationality, temperament, mental endowment, education and age, the main features of the phenomenon remain the same. That such should be the fact is but natural, if conversion is what we believe it to be.

The fruitfulness of our questionnaire was considerably limited by

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[1] Questionnaire for a Study of Conversion.

1. How long ago were you converted? At what age?
2. Were you brought up by Christian parents? What religious education did you receive? (Did you go to Sunday school? How long?)
3. Describe your life, your religious condition and your moral struggles for the period preceding conversion. Were you at peace with yourself? Did you endeavor to reform? What did you do to that end? What measure of success attended your efforts?
4. Where, on what occasion and under what circumstances, were you converted? Had you, before that moment, made up your mind that you would be converted if possible? Tell, in detail, what you meant then by conversion; why did you desire it; what did you expect of it? In what mental and in what moral disposition were you at the time? What was the state of your health?
5. Relate your conversion. What were the various thoughts in your mind and the various feelings in your heart at the moment of conversion? What affected you most deeply? Were you very much moved? By what, or by whom were you moved?
6. Describe your feelings and your thoughts immediately after conversion. Were you aware that you had experienced conversion? In what particulars had you become changed? What was temporary and what permanent in the results of your conversion?
7. If you have passed through more than one similar experience, or through other less momentous moral crises, describe each one separately, giving date of each.
8. Do you know of conversions, or of simple reformations, as of drunkards, having happened, without the influence of the Christian religion?

the lack of confidence on the part of certain people in the usefulness of psychology applied to religious phenomena, by the difficulties which a person of average culture and ordinary introspective power would naturally encounter when trying to record his own experience, and also by the antagonism of some church officials, a hostility arising from the belief, still alive in some quarters, that science and religion are enemies, and also from a fastidious delicacy, offended at an invitation to pry into sacred experiences. This seemed to one of our correspondents "worse than vivisection." If we felt the need of defending ourselves against this accusation, we should point to the wonderfully acute searchings of heart of so many devout Christians—St. Augustine for instance—made public for the edification and instruction of the people.

We desire to acknowledge here our indebtedness to Mr. Chas. Cutter, leader of the Fulton Street Noonday Prayer Meeting, New York, for the help given us in the collection of material. It is through him that the questionnaire prepared by us was published in *The Presbyterian* and in *The Christian*. He has communicated to us a great many of the most interesting answers, from which we quote in this essay.

Lack of space prevents us from publishing all the conversion-records we should like. Several of those which follow have been abridged. The name of the person and the place of residence were given in almost every case.

A. [Age fifty, converted at twenty-two, in Glasgow, Scotland.]

* * * * *

My condition was morally miserable for about a month previous to conversion. I had always been a young man of prayer. I was converted at my work. At that time I was working every alternative week at night (papermaking), and, between 12 and 1 o'clock at night I was praying earnestly to God to save me for the sake of Jesus. Indeed I cannot tell you whether I was "in the body or out of the body," but O! the light came,—it was almost too much for me. I cannot express how I felt. It was as if I had been in a dark dungeon and lifted into the light of the sun. I shouted and I sang praise unto Him who loved me and washed me from my sins. I was forced to retire into a secret place, for the tears did flow, and I did not wish my shopmates to see me, and yet I could not keep it a secret. I was constrained to tell to all around what a gracious Saviour I had found. At the moment of my conversion I was in the best of health. The only thing that troubled me was my soul. The joy and the peace that filled my soul at conversion was greater than I have felt since that period, but, thank God, there is a peace and a joy within my soul now that the friends of this world know nothing of.

B. [Converted at twenty. A clergyman.]

At the age of twenty I entered a theological seminary and remained there four years. The third year I became a member of a conversational club, whose motto was the Hebrew for "We stand united for investigation." During the course of our studies in rationalistic Biblical criticism, a night was devoted to the discussion on the Fourth Gospel, the author of the essay taking ground against the historical validity of this gospel, regarding it as a sort of philosophical writing on certain phases of Christian teaching. I remember the reader's last sentence: "The Fourth Gospel is a

great epic." By this essay the flood-gates of doubt were open me. (See conclusion, p. 339.)

(From a letter communicated to us by Dr. Burnham.)

C. [The Rev. Mr. Ch. G. Finney.]

Up to his conversion he was a young man of very good character. See pp. 324 and 330.

In the evening of the day in which his conversion took place," his heart seemed to be liquid within him." He wanted to pour his whole soul out to God's and rushed into a back room to pray. "There was no fire and no light in the room; nevertheless it appeared to me as if it were perfectly light. As I went in and shut the door after me, it seemed as if I met the Lord Jesus Christ face to face. It did not occur to me then, nor did it for some time afterwards, that it was wholly a mental state. On the contrary it seemed to me that I saw Him as I would see any other man. He said nothing, but looked at me in such a manner as to break me right down at His feet. . . . . I wept aloud like a child, and made such confessions as I could with my choked utterances." When he returned in the front office: "As I turned and was about to take a seat by the fire, I received a mighty baptism of the Holy Ghost. Without any expectation of it. . . . . without any recollection that I had ever heard the thing mentioned by any person. . . . the Holy Spirit descended upon me in a manner that seemed to go through my body and soul. I could feel the impression, like a wave of electricity, going through and through me. Indeed it seemed to come in waves and waves of liquid love. . . . I can recollect distinctly that it seemed to fan me like immense wings." During the night he awoke many times "on account of the great flow of the love of God that was in my heart. I was so filled with love that I could not sleep."

(From Finney's "Memoirs," New York, Barnes & Co., 1876.)

E. [Age forty-two, converted at thirty-three. An Oxford graduate.]

My father was a Church of England clergyman. My mother, still alive, never had, and has not now, a knowledge of salvation. I was intended from babyhood for the ministry, and had a grammar school and university career, graduating in arts at Oxford in 1880. . . . . .

At fifteen years of age I was a confirmed smoker, and used to get drunk often without the master being aware of it. At eighteen years of age I was sent to another school. . . . . My second school was a change for the worse. Here, all the older boys, with one or two exceptions, were habitual drinkers, if not drunkards. Out all night by means of duplicate keys to the school doors, was a regular thing for weeks together, and drink, smoking, and sins of all kinds (except the more horribly gross ones) were the order of the day. We were all manly fellows, and I thank God now that I am spared the humiliation of looking back upon a life tainted by the abominations which prevailed in some of our larger public schools. About two and a half years of this brought me up to the age at which I should enter upon my university career. I went to Oxford and gained my scholarship or exhibition in the usual way. A reckless, drunken and otherwise impure life passed by quickly enough, and I found myself a graduate, ready, as my poor father thought, to take orders at once. Alas, alas! nothing was further from my mind than the ministry. I knew absolutely nothing of God. Up to thirty-three years of age my whole life was one of routine religion. Between the period of leaving Oxford and my conver-

sion, I never darkened the door of my father's church, although I lived with him for eight years, making what money I wanted by journalism, and spending it in high carousal with any one who would sit with me and drink it away. This was a source of much trouble to my parents, who saw my talent and education thrown away, owing to my inability to settle down to steady work. But I had grown weary of religion as I had seen it. Eight years, between my degree at Oxford and my conversion in 1886, seems a long time now to have wasted in a small village with two inns only. But it went by very quickly, in the way I lived. I was young and handsome, of tremendously powerful physique, and was a general favorite with the girls. This, I suppose, was a great factor in enabling me to live a life so different from the one I might have lived, had I turned to and gone earnestly to work. Anyway, so I lived, and would probably have gone on living had not God turned me around and compelled me to go another road. Sometimes drunk for a week together, and then a terrible repentance, and not touch a drop for a whole month. I never got beyond that period, except once, when I joined the Good Templars, in the hope that the restraints of this body would keep me in check. I did very well for nearly three months, but a Good Templar at last broke me, and we both ceased to attend the meetings, and were knocked off the roll. In all this period, that is, up to thirty-three years of age, I never had a desire to reform on religious grounds, but all my pangs were due to some terrible remorse I used to feel after a heavy carousal; the remorse taking the shape of regret after my folly in wasting my life in such a way—a man of superior talents and education. I was not much alarmed about the future world; I did not believe it to exist, at any rate. This "terrible remorse" turned me gray in one night, and whenever it came upon me I was perceptibly grayer the next morning. What I suffered in this way is beyond the expression of words. It was hell-fire in all its most dreadful tortures. Often did I vow that if I got over "this time" I would reform. Alas, in about three days I fully recovered, and was as happy as ever. So it went on for years, but, with a physique like a rhinoceros, I always recovered; as long as I let drink alone, no man was as capable of enjoying life as I was.

I was converted in my own bedroom in my father's rectory house at precisely 3 o'clock in the afternoon of a hot July day (July 13th, 1886). I was in perfect health, having been off from the drink for nearly a month. I was in no way troubled about my soul. In fact, God was not in my thoughts that day. A young lady friend sent me a copy of Professor Drummond's "Natural Law in the Spiritual World," asking me my opinion of it as a literary work only. Being proud of my critical talents, and wishing to enhance myself in my new friend's esteem, I took the book to my bedroom, for quiet, intending to give it a thorough study, and then write her what I thought of it. It was here that God met me face to face, and I shall never forget the meeting. "He that hath the Son hath Life Eternal;" "He that hath not the Son hath not Life." I had read this scores of times before. But this made all the difference: I was now in God's presence, and my attention was absolutely "soldered" on to this verse, and I was not allowed to proceed with the book till I had fairly considered what these words really meant and what they involved. Only then was I allowed to proceed, feeling all the while that there was another being in my bedroom, though not seen by me. The stillness was very marvelous, and I felt supremely happy. It was most unquestionably shown me, in one second of time, that I had never touched the Eternal, that is,

God; and that if I died then, I must inevitably be lost. I was undone. I knew it as well as I now know I am saved. The Holy Spirit of God showed it me in most ineffable love; there was positively no terror in it; I felt God's love so powerfully upon me that only a mighty sorrow crept over me that I had lost all through my own folly, and what was I to do? What could I do? I did not repent even; God never asked me to repent. All I felt was, "I am undone," and God cannot help it, although He loves me. No fault on the part of the Almighty. All the time I was supremely happy; I felt like a little child before his father. I had done wrong, but my Father did not scold me, but loved me most wondrously. Still, my doom was sealed. I was lost to a certainty, and being naturally of a brave disposition I did not quail under it, but deep sorrow for the past, mixed with regret for what I had lost, took hold upon me, and my soul thrilled within me to think it was all over. Then there crept in upon me so gently, so lovingly, so unmistakably, a way of escape, and what was it after all? The old, old story over again, told in the simplest way, "There is no name under heaven whereby ye can be saved except that of the Lord Jesus Christ." No words were spoken to me; my soul seemed to see my Saviour in the spirit, and from that hour to this, nearly nine years now, there has never been in my life one doubt that the Lord Jesus Christ and God the Father both worked upon me that afternoon in July, both differently and both in the most perfect love conceivable, and I rejoiced there and then in a conversion so astounding that the whole village heard of it in less than twenty-four hours.

After passing through the scene with God in my bedroom, I went to the rooms downstairs to relate what I had experienced to anyone who would listen. All saw I was a wonderfully changed man, very subdued and quiet, but out of a family of six grown-up sisters,a brother, a father, and a mother,—only one, a widowed sister, two years older than myself, really understood what had taken place, and she was rejoiced beyond measure, and said that I had received a glorious conversion, and that she always knew that I would be saved at last, although it looked so bad against me. But a time of trouble was yet to come. The day after my conversion I went into the hay field to lend a hand with the harvest, and not having made any promise to God to abstain from drink in moderation only, I took too much and came home drunk. My poor sister was heart-broken; and I felt ashamed of myself and got to my bedroom at once,where she followed me, weeping copiously. She said I had been converted and fallen away instantly. But although I was quite full of drink (not muddled, however), I knew that God's work begun in me was not going to be wasted. It was no good to pray in that state,—I had not prayed for twenty years,—and, wishing my sister good night, I said with the utmost simplicity, "You don't know all that has occurred to me; it is all right, and although I am drunk now, I love my Saviour with a love I cannot express to you." And so she left me for the night, somewhat more reconciled. Next morning I was very low indeed; still I felt that God was not going to lift me up like that and then let me fall into lower depths at once. About mid-day I made on my knees the first prayer before God for twenty years. I did not ask to be forgiven; I felt that was no good, for I would be sure to fall again. Well, what did I do? I committed myself to Him in the profoundest belief that my individuality was going to be destroyed, that He would take all from me, and I was willing. In such a surrender lies the secret of a holy life. From that hour drink has had no terrors for me; I never touch it, never want it. The same thing occurred with my pipe:

after being a regular smoker from my twelfth year the desire for it went at once, and has never returned. So with every known sin, the deliverance in each case being permanent and complete. I have had no temptations since conversion, God seemingly having shut out Satan from that course with me, but he gets a free hand in another way, but never on sins of the flesh. Since I gave up to God all ownership in my own life, He has guided me in a thousand ways, and has opened my path for me in a way almost incredible to those who do not enjoy the blessing of a truly surrendered life.

P. S.—Written at one sitting, and not meant for publication as it stands.

[The writer of this letter is now married and has four children.]

F. [Age twenty-one, converted at sixteen. Brought up in a Christian home. Attended the Wesleyan Sunday school from the age of four to fourteen.]

At the age of fourteen I thought that if I went to a place of worship once every Sunday, that would be all the religion I required. "Was I at peace with myself?" Far from it. There were times when I felt most miserable. I felt my moral nature sinking while I was trying hard to find something higher. I endeavored to reform, but my moral surroundings were too strong for me; so my efforts were all unsuccessful.

On the night of February 23d something tempted me to go to the Wesleyan Chapel of my childhood days. Rev. A. Wood was preaching from Luke x: 5-42. The words came home to me. I felt that there was something else needed in my life; the sermon had made me feel miserable. In this state I remained for fifteen hours. For five months previous to this I had felt that I would like to be converted; but the moral forces of my workshop (which was in a piano forte factory) seemed too strong for me. My moral disposition was somewhat crushed by the sense of my sins. My mental condition, like my health, was good. On February 24th between 11 and 12 A. M., I could bear the weight of my sins no longer. I thought if ever I am to be converted, why not now? So locking the door of my workshop, I fell on my knees and prayed in the language of hymn 327 in "Sacred Songs and Solos." And immediately a voice seemed to say to me, "Thy sins which are many, are all forgiven thee." At this moment I was filled with wonder. Arising from my knees I knew that I was converted. I was affected most by my sins and my Saviour's great love, but I do not remember that I shed a tear.

Immediately after conversion I felt somewhat like a stranger in a strange country; everything seemed new to me. Yes, I knew for a certainty that I was born again. My whole life was altered. And I saw everything under a different aspect from what I had done before. As far as I know, everything that was good and true became permanent. . . . . .

G. [Age forty, converted twenty months ago. Superintendent of a mission.]

Until the age of twenty-one he lived in a Christian home. He took his first glass of whiskey at that age, and gradually became a drunkard. Three years ago, after the ruin, through dissipation, of his business establishment, he went to Canada, where no one knew his antecedents, with the intention of beginning life anew. But soon he fell a prey to his old enemy. He had signed enough abstinence pledges to "cover the wall of a room;" they were never

kept more than a month, generally only a few days, and sometimes but a few hours, in spite of hard struggles to be true to his promise. In Montreal he lost a very good position ($70 a fortnight), and was thrown into prison for disorderly conduct. Disgusted and tired of life, he left Canada to go to W. Here he arrived intoxicated. He secured a position, but was soon dismissed for drunkenness, and then found himself once more without money, without friend and without home. Gladly would he have welcomed death. As he was in this wretched situation, a lady showed him sympathy and invited him to a mission. Her kindness made him look within. For years no one had ever cared about him; this unwonted kindly interest went to his heart. At the meeting a pressing invitation was given to all persons present to give themselves to the Lord Jesus Christ with the assurance that He would save them. A bed was given him in the mission house. While his room-mate lay drunk, he sat up, or paced the room all night long in a sullen, despairing mood. Some one had lent him a Bible; he tried to read it, but his thoughts were too disturbing. That which he had heard in the meeting had brought to his mind recollections of youth, the thought of the young wife he had left in England, of his family, etc. He realized that there was no hope, that if he died then he would go to hell. He prayed asking God to take him as he was; saying that if He was willing to save him, he would let Him. "I said, here I am." At about 6 A. M. he felt that God had pardoned him. The anguish of the night had passed, and he found himself calm and peaceful. That very morning he told a companion that he was converted, that he had given his heart to God. Terrible were the temptations that day as he passed before the saloon doors; but he was kept. They recurred day after day for more than a week. The lady's continued sympathy was a great comfort to him.

Three months after his conversion he opened a mission, which progressed rapidly, and is now doing very good work among drunkards and other outcasts.

(Written from detailed notes taken while he was relating his conversion to me.)

H. [Age thirty-five, converted five years ago. Hotel waiter. Public school education.]

Until the age of fifteen he lived among religious people. Subsequently he left home, fell into bad company and became a drunkard. He abandons his wife, sleeps in the open air and becomes a tramp. In that condition he feels very unhappy and lonely. He is without friends. He has remorse at the thought of his mother, who grieves for him.

On the 28th of November, 1889, while he was seated in Central Park, N. Y., a young man entered into conversation with him, and invited him to go in his company to a religious meeting. The kindness of the stranger moved him deeply; he did not understand why a well-dressed stranger should care for him and be willing to walk with a raggedly clad fellow like himself. At the meeting he heard the testimonies of those who had also been wretched castaways, and who were now happy disciples of Christ. But the beautiful things he heard could hardly be for him; he was surely lost. After the meeting the stranger knelt with him, and they prayed together and wept like children. He promised God that he would serve Him; and gave himself to Him body and soul. Peace came to his soul as he was praying in that spirit, and he felt himself pardoned of all his sins. He declared then publicly that from that moment he would begin a new life. He felt God in his heart; he knew that

he was regenerated, and although he did not know where to find shelter for the night, he felt assured that God would always help him. He went to his wife and told her of his conversion. The new light on his face convinced her that a great change had taken place in him, and they began life anew together.

(Communicated by a friend who obtained this story from the person himself.)

I. [Age fifty-four, converted at forty-five.]

My Christian mother died when I was seven. My father was a drinking man, and nominally a Methodist. Up to the age of twelve I had but very little religious or any other kind of education. It was a life of neglect and often hunger and misery. At the age of twelve I was adopted by my godfather, ... and had the blessing of a Christian home. I became a member of the Sunday school of Saint Paul's Church, N. Y. . . . . In course of time I was confirmed and became a member of the church. I was active in all the externals of church life and work, became Sabbath school teacher, member of the Young Men's Association, etc. From 1853 to 1860 I was clerk in my uncle's office. He was a magistrate and had a legal practice.

I got into society at nineteen and was fascinated with dancing, parties, billiards, etc. I commenced smoking at nineteen, and drinking at twenty-one; then followed theatre, gambling, licentiousness and deeper forms of sin. I was leading a dual life, deceiving my uncle and aunt, maintaining an outside semblance of morality, attending church, etc., but living a lie before God. For I had no religion. I had been a respectable and moral church member, but there had been no new birth. . . . . I plunged deeper into drink and dissipation of all forms, until the risk of discovery by my friends in my home became so imminent and I was so utterly reckless that I ran away from home in 1863 to enter the army. I served to the end of the war and came out of it hardened, callous and indifferent. Drink, profanity, cards and sinful amusements of the viler kind occupied my life until 1869. There was no peace. There was a reckless defiance of any religious suggestion, a willful pleasure in sinful enjoyments, resistance to the voice of the Spirit, a mental and physical effort to shut God out of my life. In 1869 I tried to reform and joined the "Church of the Stranger." For about three years I maintained a fairly moral condition by constant struggles and self-efforts. I was regular in the perfunctory duties of church membership, and active in various forms of benevolent work in that church and in the Y. M. C. A., as Sunday school teacher, etc. There was not then, and I knew it, any real inner life, no spiritual joy, no love to the Master: it was a painful forcing to religious duty, and not a spontaneous following of the divine Voice and impulse. The end was a failure. . . . The house had been swept and garnished and made ready for the seventy devils that took possession.

From 1872 until 1886, with some intermission, I continued the life of slavery to drink and all the grosser sins that go with it. For a short period before and after my marriage in 1878, I reformed from drinking, but there was no religious experience attending it. I did try at intervals to stop drink by self-resolutions, promises, pledges, only to fall back weaker and deeper down than before. . . . . I at last abandoned all efforts and let the tide rush as it would, indifferent to everything human or divine, and often tempted to suicide. How I bless God for saving me! Oh, what love, what wondrous love that saved such a sinner as I was!

When I got utterly hopeless, helpless, in the darkest despair, when I felt the slavery of sin, ... its physical and spiritual consequences, when I knew and realized that I was utterly and forever lost, so that I dared not even pray, and yet there was just the shadow of a wish, the faintest suggestion of a desire to be free, then God raised up a human instrument. My employer put me in the "Christian Home for Intemperate Men." I went there willingly, gladly; I would have gone anywhere to get away from the hell that was eating away my body and soul. I had not had any special thought of seeking help by the gospel until I went there. I first realized something of hope when I was told that the grace of God alone could save me. I had of course a theoretical knowledge of the plan of salvation, but my heart was dead to any special desire for righteousness for Christ's sake. I wanted to escape from the evil effects of my sins in my physical life, but I do not specially recollect any desire to seek deliverance from all my sinful nature. Conversion had no special meaning to me. I entered the home, hoping that I would escape from drink, recover good health and get back to my family. I spent two weeks in the home, from the 24th of May to the 7th of June, under the quieting influences of religious meetings and bodily and mental rest. . . . . I did not make any special effort towards conversion; I could not understand just what faith meant. Yet I enjoyed the prayer meetings, read the Bible, sung the hymns, prayed morning and night; but there was no special sense of relief, or joy or peace. Conscience was blunt in a great measure. In the hour spent with Manager C. A. Bunting, in his study, with the Bible before him, in the afternoon of June 7th, 1886, I realized that I needed a power from outside of myself, a power that could save. He offered me Christ's, and read John iii: 16, "Come unto me all ye that labor, etc.," and other passages. He prayed, and I also. By every conscious effort of my mind and will, I surrendered myself to the power of Jesus, taking Him as my Saviour, trusting His word, and committing myself as fully as it was possible by my volition, to Him. I fully realized that I had no other source of hope for salvation except Him. Yet I believe that the thought was more to escape from the bondage of the appetite for drink than from the whole sinful man. I know that my heart was at rest, and I experienced a feeling of safety and relief when I voluntarily made what I called "a full plunge," and completely surrendered to God's Grace. I think, however, that I thought more about myself and my deliverance than about God or His love. There was no convulsion of feeling, no tears, no bitter agony. It was a simple quiet act of surrender, followed by a consciousness of rest and peace, and a willingness to do and to be just what God would have me. Mr. Bunting questioned me as to my belief, and my answer was that I trusted all God's Word said. He claimed salvation for me and told me that I had received it. I simply believed it. The thing I do know is, that so far as the appetite for liquor, tobacco and other forms of vicious indulgence is concerned, it was taken completely away, and has never returned to this moment, not even a suggestion or longing in the slightest degree. "Old things passed away, and all things became new."

There was a gladness at the sense of release from bondage, and a knowledge of a forgiveness of sin and of salvation. The condition of mind, thought, body and soul may be described in one word—peace. . . . . I know also that there came into my heart an intense desire for righteousness. I gradually became conscious of the inward Voice, warning, teaching, guiding, making conscience quick and tender.

One of the first experiences I had was within a year of my acceptance of Jesus as my Saviour. At a meeting I offered myself voluntarily for service to God. Quicker than thought the spirit admonished me that I had wronged a man, and I must confess and right that wrong. I had an awful struggle with myself for a year. Every time I prayed, this thing would come up. I debated with myself and with the Lord and tried to convince myself that I need not do this. I saw no way out of it, nor how to make right the wrong, as I was strapped with debts, and prospects were very gloomy. . . . . God at last gave me the grace and courage to overcome my pride and write to this man, one who had greatly helped me in former years. I found a deeper peace and a greater gladness than I ever had before. It confirmed my faith in the reality of God's Word, Christ's work and my own conversion.

Moreover the Lord has abundantly fulfilled His promises in giving me wondrous prosperity and success, and enabling me to restore what I had wronged.

I have learned to look to Jesus as my righteousness and sanctification. He delivers me from self-effort, struggle, unrest and self-condemnation; it is simply a life of growth by constant trust.

K. (Age seventy-three, converted at sixty-four.]

I attended Sunday school irregularly. My heart went out to the pleasures of this world, as far back as I can remember. The deeper I drank of the sinful pleasures the more I loved them. I commenced drinking and smoking at about sixteen years of age. Later, when my appetite got such a strong hold upon me, I endeavored to reform in my own strength, but I always found it a miserable failure, and then, how I would regret that I had fallen into those sinful habits. Then I would sink back into despair, deeper and deeper. I often wished I had never been born.

I got under conviction the first time I saw the Salvation Army on a march. I was playing pool. I went to the door with the rest of the men to see the Salvation Army. God sent an arrow of conviction to my soul, and for the first time I saw it as God sees it; O, how vile and black my heart looked! I thought that I would give the whole world to become as good as those Salvation Army people. I began attending their meetings in the opera house. The oftener I went the more miserable I became; but I could not stay away—there seemed to be some unseen power that forced me to go, and so I went until I could endure it no longer. The night I went to the altar it seemed to me that it was a last chance for me. I went to the altar to give my heart to God, not a part, but every idol, my time, my talents and all. I made a full surrender of everything, and God for Christ's sake set my captive soul free. The chains of hell were snapped, and I was a free man in Christ Jesus. My pen fails me to describe the joy that thrilled my soul as I received the witness of the pardon of my sins. The world and all its charms, which I loved so dearly a few moments before, had vanished, and nothing but perfect love filled my soul to overflowing. I looked at myself in astonishment and wonder; my heart a little while before I gave it to God was full of wicked thoughts,—murder, hatred, deceitfulness and pride,—and now all these things were cast out and nothing but profound love had taken their place; how can a child of God describe these feelings! I can truly say "the love of God passes all understanding." Praise God!

At the time of my conversion my health was not first class. I had lived in dissipation for over forty years.

L. [Age fifty-four, converted at forty-four. Superintendent of a Rescue Mission.]

My parents were not professing Christians. I went to Sunday school only as I took the notion, and that was very little.

When I was nearly eighteen years of age I went into the army. There learned not only to drink, but all the mean and sinful things that follow in its train. When I came out of the service I followed the life of a sailor, and later that of a bar-tender. My life was one continual round of dissipation. I had no desire for anything good, only, at times, there would come a longing in my heart for something better. But it was soon over, and I would if possible go deeper into sin. This continued for about twenty-six years, or until I was forty-four years of age, when one day a lady came into the place where I was selling liquor and asked for the privilege of distributing tracts. I entered into conversation with her and became interested to such an extent that I called on her. The result was that I became sick of the business I was in, and gave it up. But I did not have any desire to become a Christian at that time. I still continued in sin until I felt that I would die if I kept on in the same way. I did not realize that I was a sinner, only that I was a drunkard. And I think my prayer was, "Oh Lord, take away this appetite, I cannot do it myself." It had been a long time since I had had a good night's sleep; but that night I slept well without any stimulant. And I praise the dear Father that I have had no desire to use them since. Ten days later I gave myself wholly to God as far as I knew. But with me it has been a growth in grace. I was very ignorant, knew nothing of God's Word, but He has led me on, and to-day I have an assurance in my heart that I am saved by the blood and kept by the dear Saviour.

I do not know whether I have made myself explicit, but one thing I want to say: I believe that God took away the appetite for drink that night when I asked Him; but I also believe that I was not converted until some days after. I never have had that ecstasy which some profess, but I have always had an assurance that I was saved since I gave myself wholly to Him.

M. [Age thirty-three, converted at twenty-seven. A professional base ball player.]

Parents were not Christians. I received very little Christian education. I was an only child of parents in nice circumstances and received a very good education. I was petted by my parents. At the age of fifteen a religious wave swept over the land. I rose for prayer at a meeting and soon began to lead a different life, but did not continue over one year. At the age of eighteen I left my home and soon began to drink hard. Some years after, I married, but continued to drink and blaspheme, and go to houses of ill-fame as before. I sought for peace and satisfaction in almost every kind of worldly pleasure, but could not find it. I traveled as a professional base ball player, made a great deal of money, spent it, and deprived my wife and two boys God had given me. Soon after my marriage I became an infidel; many of my relatives are such. As I saw myself drifting down, and friends who at one time would have gladly recognized and courted my company shunned me, I sometimes was almost at the point of asking God to forgive me and make me a better man. I often tried to reform in my own strength; but at each attempt I found I had less and less strength. I signed pledges, made promises, and broke them as fast as I made them, until my health was impaired, my intellect affected. I became a wreck,

separated from wife and children. Poverty stared me in the face almost always; sometimes I would sell a chair or a bit of jewelry to keep the wolf from the door. For some time I was in the drink business with my father. On an average I drank forty drinks of whiskey a day, and I cannot tell how much beer, but it would not make me drunk. I left that business and came to Passaic, where my wife and children joined me. There I went in "good drinking society"—business and sporting men. My wife by this time had learned to take a glass, and my little children loved it. I sent them daily to the saloon to buy it. I grew more and more morose and gloomy at home; curses and kicks for the little ones were a daily occurrence. Friday, Saturday and Sunday of the first week of October, 1888, I drank very hard and was very cross to my wife and children, but on the Sunday evening as I came home, I felt rather sorry I had been so bad, and told my wife: "If you would like to go home to Trenton on a visit, you can go." She went on the following Monday morning. I slept at home. I had drunk nothing that morning. At night I thought I would not go out, and so remained in my house without drinking. Neither did I drink on Tuesday nor Wednesday. I spent the evening at home. My mind was quiet, and my health at the time very fair, having been without drink for three days and nights. Wednesday I went to bed early; I felt rather lonely on account of the absence of my wife and children. The house was very quiet. I had not been in bed twenty minutes before I became perfectly conscious of God on my right hand; and all at once I felt the bed dropping, or it seemed so to me; it was just the sensation a person experiences on going down stairs. It seemed as if each step took me farther and farther away from God, and nearer to hell. God spoke to me. (You must remember that I was at this time in open infidelity; I had not been in church for ten years, and, for years, I had not had any Bible in the house. I could not quote a verse of the Bible, except, perhaps, "Jesus wept.") This night God spoke so distinctly that it seemed I heard His voice. He said to me, "Thus far shalt thou go and no further. You have despised Me and My Son. You have gone into the ways of sin and death. Now you are guilty and condemned." And as I lay on my back on the bed, it seemed as if every sin I had committed came before me. God spoke again as at first and added: "If you will turn to Me now, I will forgive you." I had not prayed since I was a boy, except to say sometimes, "God help me." I did not know what conversion meant, and never intended or expected to be a Christian. God said, "Get out of your bed, kneel down and pray to Me"; but just at that moment it seemed as if the devil was present; I felt I could touch him. He said, "Don't you do it, you don't believe in God or His Son. Religion is only fit for a lot of weak-minded women and children, but not for a man like you; besides think of what every one will say." But God spoke again and said, "Now is the time; if you will come to Me, I will forgive and save you from going to hell." All the time the bed seemed to be on its way down to the pit. I thought, "Well, now it is just below;" I seemed almost to hear the devils shrieking; the very breath of the pit seemed to be around me, but my mind was perfectly clear. God said, "Get out of bed, kneel down and pray." I did not know how to pray, but wanted to. And the devil spoke so clearly that it seemed I could hear him a long way off: "Well, if you want to do right, go ahead, that is all right, but do it in a manly way; give up drinking and swearing, but don't ask God to help and save you; you are so bad, He will not help you." O, what a liar he is! But the good loving Father seemed to continue to wait at my bedside;

and, I don't know at what time of night, I finally got out of bed and fell on my knees, feeling that God was angry with me. I just said, "O God, won't you have mercy on me?" Then I got up and went to bed, and fell asleep. When I woke up the next morning I had forgotten all that had happened during the night. As I was crossing the street to go and get my breakfast, a voice said to me, "Don't you remember what happened last night? You had better ask Me to help you out to-day." So I said, "Lord, please keep me from drinking and swearing to-day, will You?" and I went to my work.

As I got out of bed the night before and knelt down, a vision came to me: a number of stairs looking somewhat like a pyramid, and between each stair there was a passage of Scripture, such as "All have sinned and come short of the glory of God"—"Him that cometh to Me I will in no wise cast out," and many others, until it seemed as if the stairs, with Bible promises, reached from earth to heaven, and at the top I saw the blessed place, and God Himself sitting there. O, how miserable I felt. This vision continued with me until the following Monday night; during that time, day and night, I saw myself a poor, wretched, hell-deserving sinner; for I had defied the loving God to His face. It seemed as if every sin I had ever committed was constantly before me. That Monday night, as I was on my knees, all alone in the house, there seemed to flash instantly a light surpassing the light of the brightest sun. I was conscious of the presence of Him whom I had insulted, rejected and crucified. My whole being seemed to melt, and I heard Him speak words that at that time I did not know were in the Bible. He said, "Son, thy sins which are many are all forgiven thee." It seemed as if I saw Him; I felt the joys of the ransomed in the beautiful City of God. It seemed as if Jesus Himself had come into my body and took full possession of me. I did not know, though, that I was saved, as we call it now; but I knew God had had mercy on me. I felt, and knew, I was a different man. It seemed as if the birds sang sweeter, the sky looked bluer. Everything about me praised God, and a sweet sense of His presence was with me. I had such a horror of the old life that it seemed I must obey God in everything. . . . I have never gone back to old ways and habits; I have been kept by the power of God alone. To Him be all the glory.

[He began then to warn his associates, and to speak to them of the love of Jesus.]

Some ten or twelve months after, my wife, a Roman Catholic, was converted, and our home changed from hell to heaven.

In our work here we have some cases of drunkards converted without the influence of the Christian religion, directly awakened by the Spirit of God.

O. [Age forty-four, converted in 1883. A business man.]

Born of Christian parents belonging to the Lutheran church. At the age of sixteen he passed through a "religious experience." At about eighteen became a commercial traveler and fell away from his former good conduct. He began to drink, and from time to time would get drunk. Many times he made pledges to abstain from alcoholic beverages, but broke them after a few days or, at most, two weeks of abstinence. For fourteen years he went on that way, though never falling to the rank of the habitual drunkard. He was not happy; his conscience reproached him with the slavery under which he had sunk. Often he formed resolutions to overcome this humiliating and degrading habit, and every time passion had the best of his determination.

One Sunday, in Louisville, having company, he remained until 1 A. M., drinking and singing. When left alone he lay on his bed full of shame at the thought that he had once more degraded himself. During the evening they had sung some hymns; now they came back with a crowd of memories of home. He was deeply stirred and promised God that he would never touch another glass of liquor. What distinguished this crisis from the former was the profound conviction of his powerlessness. Until then he had never lost confidence in his ability to overcome his passion; this time he felt that he "could not break it off." He had no thought of Christ, or of any Christian doctrine. He felt utterly defeated and threw himself on the mercy of God for deliverance, ready to do whatever He should command.

On Monday he had no desire to drink, and since that night no liquor has ever entered his mouth. Since that day he has not had to surmount strong temptations.

The following year he joined a temperance association, and later became president of a large "reform club."

[Written from detailed notes taken while the person was giving me an account of his conversion. I have kept his own expressions as far as possible.]

P. [Converted at seventeen. A New York merchant.]

He was from his youth surrounded by Christian influences and maintained a pure life.

"When I was seventeen [in 1886] the evangelist, D. L. Moody, was holding a series of meetings in Brooklyn. A friend of mine, member of the Y. M.C. A.,told me of the work he was doing in connection with these meetings [visiting, distributing cards, and the like]. I became interested and wanted to go and see. During the week preceding the meeting in which I was converted, I had premonition that a great change was coming. I had a very clear and vivid idea of sin. Many times I tossed in bed and kept awake, afraid of the judgment. I knew I would be lost. The strongest influence that drove me to give myself to God was the thought of the *judgment itself*, not the fear of punishment. I felt that I had no answer ready; my mind did not go further. For about a year before conversion I had been disturbed in mind and desired to be converted. During the week I speak of, I felt hopeful,while before I thought there was no hope of my being converted. I could not account for that hope. I began to feel more at peace. I think that this was due to somebody who, as I learned afterwards, was at the time praying for me. At the meeting the text was, 'Is the young man Absalom safe?' It seemed to fit my case. It became clear to me during the meeting that all hope was gone; the thought uppermost in my mind then was that I could never get salvation.'"

[See continuation, pp. 334 and 335.]

"Since that day I never let a night pass without squaring accounts with the Lord."

[Taken down as near as possible as verbally given me by the person himself.]

Q. [S. H. Hadley, superintendent of the old Jerry McAuley Water Street Mission, New York.]

". . . . . I gave up my studies, took a traveling position, became a professional gambler, and for fifteen years rarely went to bed sober." He finally lost his position. "One Tuesday evening, on the 18th of April, 1882, I sat in a saloon in Harlem, a homeless, friendless, dying drunkard. I had pawned or sold every-

thing that would bring a drink. . . . I had not eaten for days, and for four nights preceding I had suffered with delirium tremens. As I sat there thinking, I seemed to feel some great and mighty presence. I did not know then what it was. I did learn afterwards that it was Jesus, the sinner's Friend. I walked up to the bar and pounded it with my fist until I made the glasses rattle. I said I would never take another drink if I died in the street. . . . Something said, 'If you want to keep that promise go and have yourself locked up.' I went to the nearest station house and had myself locked up." In his cell he felt the impulse to pray and prayed. The following day he went to the home of his brother, and in the evening attended a meeting at the Jerry McAuley Mission. [For the conclusion see pp. 331 and 332.]

The conversion of President Jonathan Edwards, of the Rev. John H. Livingston and of Mrs. Eleanor Emerson have been published by the American Tract Society.

For John B. Gough's case, see his "Autobiograpy."

For Colonel James Gardiner's conversion, see his "Biography" by P. Doddridge, D. D.

For that of the Rev. Mr. Jeremiah Hallock and of the Rev. Mr. A. Nettleton, D. D., see their respective Memoirs.

For that of the Rev. J. O. Peck (case D.), see quarter centennial sermon, delivered by him in Brooklyn, October 21st, 1883.

COLOR-SATURATION AND ITS QUANTITATIVE RELATIONS.

By A. Kirschmann.

Without considering their dependence on time and space, our sensations of sight are variable in three directions:

I. In the strength of the sensation as light, that is, in brightness or *light-intensity*.

II. In the quality of sensation, that is, in its color or *color-tone*.

III. In the strength in which the special color-tone is perceived independently of its light-intensity, that is, in its *color-saturation*.

The first two of these variables are commonly understood and evident. The third is not generally recognized, and the necessity of its introduction is disputed. It requires, therefore, a further explanation.

If all qualities of light were coördinate, there would be no necessity for introducing a third variable, but since one of the qualities, that of the uncolored (so-called white) light, plays an exceptional rôle, we are not able to represent all possible light-sensations by a two-dimensional system or by an expression with two variables. All those qualities commonly known as colors or color-tones form a closed manifoldness, in which there is a gradual transition from any particular color to any other. All qualities in this manifoldness are coördinate, and every one can be regarded as a transition between its neighbors; *e. g.*, the different tones of green form the transition between yellow and blue, as blue is the transition between green and violet, and so with all colors. The transitions are integral parts of the whole manifoldness, and together constitute it.

All these qualities are variable in intensity. If we represent the manifoldness of color-tones by a straight or curved line of any form and length, we must represent the system of all possible degrees of intensity of these various light qualities by a plane or curved surface. This state of affairs is not changed even if we regard uncolored light as a coördinate quality and give it and its degrees of intensity a place with the others on that surface. But it will be easily seen that

thereby the transitions between uncolored light and the various colors are not included; for between uncolored light and every color-tone there are transitional qualities, which are neither colorless nor one of the color-tones of the above mentioned manifoldness. In order to give all transitions of this kind a place on the two-dimensional representation, we should have to interpose uncolored light between every two neighboring color-tones, which would contradict the conditions upon which this surface was constructed.

Hence, if we are to represent by a space construction all possible color-sensations, including these transitions between colorless light and the various colors, we must make use of the third dimension, or, in other words, we must introduce the third variable. This third variable of light-sensation, according to which there is an infinite or at least a great number of transitions between any color-tone and colorless light, constitutes what we call, after Wundt, "the saturation of light sensation." Three-dimensional constructions which take into account this third variable are the *Color-pyramid*, first commended by Lambert;[1] the *Double-pyramid* and the *Color-sphere*, both devised by Runge;[2] and the Color-cone or Double-cone described by Wundt.[3]

In passing we may be allowed to interpolate some remarks on the physical theory of colors and a suggestion concerning a correction of the color-cone.

1. It is said that the color which forms the transition between red and violet, purple, is not a simple color, but a mixture of the two ends of the spectrum. On the contrary we hold that purple is not only as a sensation just as simple as any other color-tone, but that it even has the same right as other colors to be called a constituent part of the white light. We are guided in these assumptions by the following reasons:

In a ray of white light all wave-lengths are in the same space; every one coöperates at every point of the ray with every other, especially with those which are, as regards wave-length and vibration-number, its nearest neighbors. In a linear spectrum the wave-lengths of the extremes are deprived of their right to act together. The ends of the spectrum therefore stand under changed conditions. It is true this will have no influence if the color is really a function of the

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[1] Beschreibung einer mit Calan'schen Wachse gemalten Farbenpyramide, Berlin, 1872.

[2] Die Farbenkugel oder Construction des Verhältnisses aller Mischungen der Farben zu einander, Hamburg, 1810.

[3] Wundt, Vorl. üb. Menschen- und Thierseele, p. 114. Phys. Psychologie, 4th ed., I Band, p. 503.

wave-length, which nearly everybody to-day takes for granted, but which nevertheless is wrong, or at least uncertain. It is claimed that light of one certain wave-length causes the impression of red, another wave-length that of green, etc.; but we have that only from hypothesis, for *nobody has ever seen light of one wave-length.*

Helmholtz, to whom we are so greatly indebted for his works on optics, has pointed out that the purity of a spectrum stands in reciprocal relations to the width of the slit of the spectroscope, but he did not draw the proper inferences from this proposition, for he does not object to neglecting the width of the slit as something extremely small. It is true the width of the slit of a spectroscope or the distance between the lines of a grating can be reduced to a small fraction of a millimeter, and it is then indeed very small compared with the objects surrounding us; but it represents still a space of considerable extension compared with wave-lengths and vibration-numbers. Suppose we have obtained a spectrum of one meter in length by means of a slit one hundredth of a millimeter wide. Then we shall have at any point of the spectrum not one wave-length only, but a superposition of many slit-images, each corresponding to a certain wave-length. It is easily seen that the difference of the wave-lengths or vibration-numbers, which coöperate at one point of the spectrum, depends on the width of the slit. In the case supposed above the vibration-number increases in the distance of a meter, that is, from the red to the violet end (if we accept 412,000,000,000,000 as the vibration-number of the least, and 790,000,000,000,000 as that of the most refrangible ray which is visible) by 378,000,000,000,000 vibrations. If the change of vibration-number were equally distributed over the whole spectrum, the change in a part of it corresponding to the width of the slit would be $\frac{1}{100000}$ of the total change, *i. e.*, 3,780,000,000 vibrations. That same number will indicate the difference of the rays which coöperate at one point of this comparatively very pure spectrum; for on every point of it there will not be one wave-length, but many, the smallest and the largest of which differ by not less than 3,780,000,000 vibrations in a second. Since the increase of vibration-numbers is not equally distributed over the whole spectrum, the number which expresses the degree of superposition of rays will be different in the different regions of the spectrum, and it is very likely that the variation of the superposition, which does not necessarily follow the same constant as the variation of wave-lengths, has something to do with the periodicity in the manifoldness of color-sensations.

Since we have no right to neglect magnitudes such as the above mentioned, we cannot longer claim that the color-quality is a function of the wave-length. It may just as well be—and the probability for this supposition is even greater—that the color-quality is a function of the *superposition of wave-lengths*, so that to every qualitative difference in spectral colors corresponds a difference in the mode of the superposition. A further consideration shows that this superposition does not take place at the ends of the spectrum to the same degree as in the other spectral regions. At any other place in the spectrum a wave-length coöperates with its neighbors on both sides. At the extremes the rays are deprived of this possibility, the coöperation here being confined to one side only. These changed conditions at the ends of the spectrum are of course not a quality of the rays of light concerned, but a peculiarity of that special method used to separate the components of white light. If we place the red end of the spectrum and the violet end, which has about double the number of vibrations, under the same conditions as other colors, *i. e.*, if we put them together in such a way that they are neighbors and partly overlap each other, we shall see the color-tone *purple*, which is missing in the spectrum. These conditions are met in Newton's Rings, in some cases of anomalous dispersion and in the following very simple experiment. If we invert the ordinary spectroscopic arrangement, where the source of light is a bright line on dark ground and view a narrow black surface (*e. g.*, a strip of black velvet) on a bright background through a prism, we shall see a kind of inverted spectrum with red-purple in the middle. We must agree that the existence of this color does not prove anything more than that the mixture of the ends of the spectrum gives purple, but the spectrum just referred to has another remarkable property. If we regard the extremes of it, we find at the one end yellow and at the other end blue, or since the term blue is rather flexible, we may say a somewhat greenish blue. But the green proper is entirely missing in this spectrum. We think the theory according to which the color is a direct function of the wave-length cannot give a satisfactory account of this phenomenon, which can easily be explained by the above stated theory of superposition. In the experiment mentioned it is another part of the spectrum which is deprived of the possibility of the proper superposition of wave-lengths, viz., the green, which therefore must disappear, as the purple does in the ordinary spectrum. It is for the very same reason that the series of interference-colors as they are seen in the polarization-microscope does not begin, as it should according to the

theory, with the green, but with the yellow of first order.

I may mention in this connection that the inverted spectrum referred to above can be projected on a screen by means of a lantern just as well as the ordinary spectrum. In order to do this, it is only necessary to replace the usual slit by a glass plate, of which a little square or oblong part is made opaque by covering it with black paint or paper. The colors obtained on the screen by this method are, provided that the "negative slit" has the proper extension and is correctly focused, just as brilliant as those of a positive spectrum derived from the same source of light; and the objection that they were not pure enough to admit any conclusions about the cause of the absence of the green, can be proved unfounded by the following simple experiment, which I do not find reported in the optical literature known to me.

When light, reflected from a very thin sheet of mica, is examined with the spectroscope, there appear in the spectrum a number of rather sharply defined black stripes, which are caused by the interference of two components of the light; the one of these components is reflected from the front surface, the other from the back surface of the mica. The way-difference implies for all wave-lengths, for which the distance of the two reflecting surfaces is not a multiple of $\frac{\lambda}{2}$, a phase-difference also and thus gives rise to interference. The number of the stripes depends of course on the thickness of the mica. If the sheet is thick, then the distance between the two surfaces is, for many of the wave-lengths, a multiple of $\frac{\lambda}{4}$, and the spectrum will show a greater number of black bands.[1] If the sheet is very thin, it satisfies this condition for a few wave-lengths only, and the number of interference-bands will be limited. It is quite possible to split the mica to such a thickness that the spectrum shows only two or three bands. I even succeeded in obtaining films which caused only one interference-band; in this case the film appears colored for the naked eye. (The apparent color is of course complementary to that one which is extinguished in the spectrum.) These interference-bands can be nicely projected on the

[1] Lewis Wright describes in his book, "Light, a Course on Experimental Optics," a similar experiment, but the figures by which he illustrates it can not be correct, for in a dispersion-spectrum, which his illustration apparently represents, the distance between the bands should increase from the red to the violet end. The distance of these interference bands, which can be obtained so easily and with so simple means, might serve well for determining the wave-lengths.

screen, if arrangements are made, so that the light before passing the slit is reflected from the mica-film. Now, if we use, instead of a slit, the above mentioned arrangement for producing an inverted spectrum, the interference-bands can be seen distinctly. This could not take place if the colors in this case were not comparatively pure.

2. It is a mistake to place at the ends of the axis of the color-sphere or double-cone "white" and "black," for these expressions do not designate correctly the extremes of the achromatic series of light sensations. Black and white are not simple sensations, but presentations of a rather complicated composition. As soon as all knowledge about the surrounding objects, the shape and other properties of the surface concerned is excluded, we are not able to determine whether a surface is black, gray or white,—we see only colorless light of more or less intensity. In my lectures I am accustomed to demonstrate this by a very simple but instructive experiment. Black, white and gray surfaces are shown to an observer, who looks through a tube, which is blackened inside and provided with diaphragms so as to confine the visible field to about a square inch. Under these conditions the observer, who is compelled to judge simply according to his sensation of light, is not able to distinguish black, white and gray. If he is a careful thinker, who endeavors to avoid ambiguous terms where they cannot be defined, he will only see more or less intense colorless light. If he is not so careful about his expressions, or if he has not had an opportunity to examine the bearing of the terms black, white and gray, he will mix these "qualities" up. He then sees a piece of white paper, when badly illuminated, "almost black or very dark gray;" and he proclaims a sheet of black cardboard which receives the full daylight as perfectly "white."

The very same primitive apparatus may be used to demonstrate that "brown" is not a simple color-quality. An observer who was requested to determine the colors of the surfaces which he saw through the tube, and to pay special attention to brown colors, if they occurred, never made a mistake in discerning red, green, yellow, blue, violet, purple and their transitions, but he saw a dark chocolate-brown as "rose or pink," and a very dark coffee-brown as "yellow." He was shown various tones and shades of brown, but looking through the tube he always called them "red," "orange" or "yellow."

According to the foregoing consideration, we should place at the ends of the double-cone not black and white, but the minimum and maximum intensity of the achromatic series

of light sensations, or the threshold and upper limit. We may designate these limits in our further discussions and in our figure as the colorless light sensations of the intensities 0 and ∞.

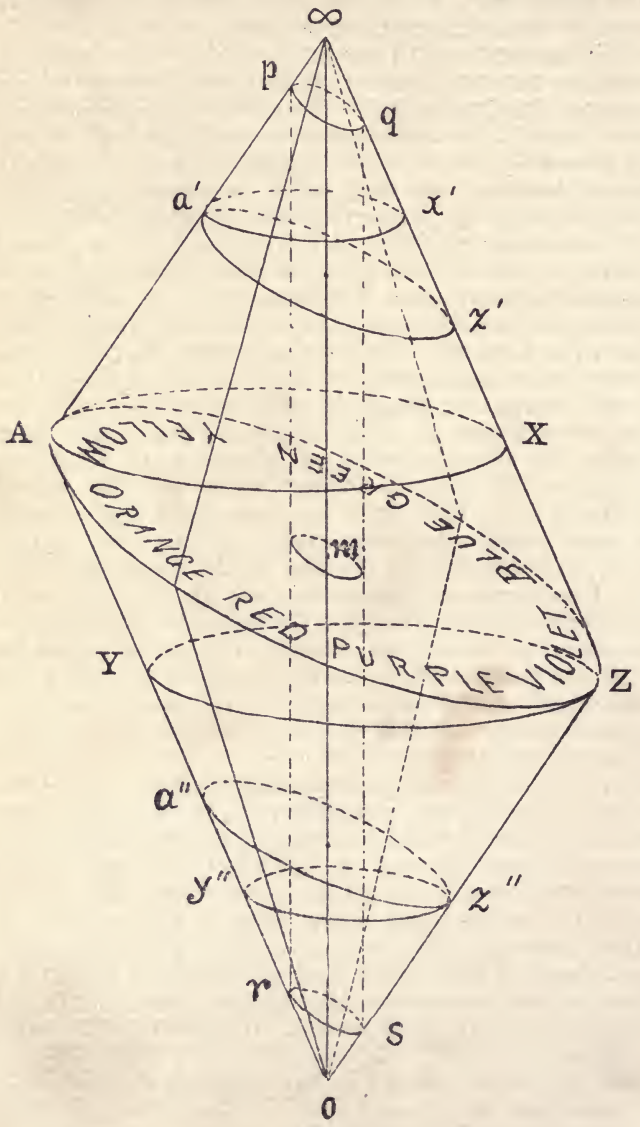


FIG. 1.

In our geometrical representations of the system of possible light and color-sensations, the series of color-tones in their highest saturation is arranged along the equator of the sphere, and in the cone along the circumference of the base. We think it necessary to give up the normal relation of this circle to the axis and to introduce an inclined position of the same as it is represented in Fig. 1. At that point of the circle which is nearest to that end of the axis which represents the maximum intensity of uncolored light sensations, we must place the brightest colors, yellow and yellow-green, and at the other end of the same diameter, *i. e.*, at that point where the circle approaches nearest to that end of the axis, which represents the minimum light-intensity, there will then be the darkest colors, blue and violet.

It is known as a fact that the manifoldness of color-tones decreases with the approach to the extremes of light intensity, and therefore the geometrical representation is not a cylinder, but a cone or a sphere. As long as we do not know the quantitative relations of this decrease, the shape of the surface, spherical, conical or otherwise, and the length of the axis are irrelevant to the theory. The same may be said to a certain degree of the angle of inclination of the color circle to the axis. On a sphere this circle will have such a position with regard to the axis as on a celestial globe the ecliptic has with regard to the equatorial axis.

Since in a sphere the length of the axis is determined by the circumference, while in the system of our light-sensations there is no direct relation between the extension of the chromatic and achromatic series, the cone, which leaves greater play to the latter, must be considered as the more adequate representation.

In the double cone with inclined position of the base are represented the three variables of light-sensations and their relations to one another. From apex to apex and parallel to this direction, we have all possible degrees of light intensity. Around the base of the cone we have all possible color-tones, and from the surface to the axis we find all possible transitions in saturation, from the maximum saturation which the intensity in that case allows, to the saturation zero, *i. e.*, colorless light.

Every plane section through the axis, *e. g.*, orange-∞-blue-0 in Fig. 1, will show a surface which contains all intensities and saturation-degrees of a pair of complementary colors, the axis forming the uncolored neutral line between them.

Every section at right angles to the axis, *e. g.*, $A\ X$ or $Y\ Z$, represents a surface with all the different color-tones and various saturations, but of equal light-intensity. Cylindrical sec-

tions whose axes coincide with that of the cone, represent surfaces of equal saturation, but of different colors and intensities.

That change of color, saturation being constant, is only within certain limits independent of intensity, is in our construction expressed by the fact that the cylindrical surfaces which represent equal saturation become shorter, the more they approach the base of the cone, where their length becomes equal to zero. That is, in other words: If I wish to go from a yellow of highest saturation to a red of equally high saturation, I cannot do this without lowering the intensity. The violet which is of the same saturation as the most saturated yellow, must be of lower intensity, and the violet which is in intensity equal to the most saturated yellow, possesses a lesser degree of saturation, while on the other hand a yellow which corresponds in brightness to the best saturated violet, must necessarily be of much less intensity and saturation than the best saturated yellow. The only pair of complementary colors which have their maximum saturation at equal intensities must be at the ends of that diameter of the base which stands at right angles to the axis; this will be satisfied somewhere near red and blue-green.

The color-cone with inclined base takes into account also the Phenomenon of Purkinje, *i. e.*, the dependence of the color-tone on the light-intensity. For every color-quality we have to assume a double threshold, a threshold of light-intensity, and a threshold of color-intensity, *i. e.*, saturation, and the two must be dependent on each other. A color, in order to be seen in its characteristic quality, must have a certain brightness as light, and the strength of the color as such must have reached a certain degree. If we assume that the saturation-threshold would be the same for all colors and intensities, we may represent this threshold by a cylinder *p q r s* in our figure, which surrounds concentrically the axis of the double cone at a certain distance. Now it will be easily seen that this cylinder cuts the surface of the upper half of the cone in a circle, which has its highest point, that is, that point which is nearest to the apex, at the yellow or orange. That means, if we increase the light-intensity of the colors, yellow and orange will be the last to lose their special color-quality. At the lower part of the cone, which represents the decrease of intensity, the opposite takes place. Here the blue and violet colors have an advantage, while, in decreasing intensity, red and orange are the first to lose their characteristic color-tone. But the Phenomenon of Purkinje shows still another aspect of the dependence of quality on intensity. All colors, when their intensity is highly increased, show a

tendency to approach in their quality towards orange or yellow, while with considerable decrease of the light-intensity a notable change towards the blue or violet-blue can be observed. This is demonstrated in our color-cone by the circumstance that the sections of equal intensity have in all cases but one, an eccentric position to the axis. If a section at right angles to the axis, representing equal intensities, be made at the middle-point m, it will easily be seen that the centre of gravity of this surface coincides with the point m. If a section be made at any place in the upper part of the cone, the centre of gravity will not lie in the axis, but will be eccentric towards the yellow; and the degree of eccentricity will depend on the distance of the section from the middle point of the system, *i. e.*, on the intensity. Thus, *e. g.*, in the section $a' x'$ of our figure, the whole manifoldness of colors possible at that intensity, is changed in such a way that its greater part is on the side of the red, orange, yellow. The opposite is the case with sections in the lower half of the double cone, *e. g.*, $y'' z''$, where the centre of gravity for every section of equal intensity is eccentric towards the blue or violet, and in consequence of this the manifoldness of colors is moved towards these qualities.

There are still some writers on the subject of color-sensations who seem to hold that saturation, *i. e.*, the third variable of light-sensation, is an illegitimate and unnecessary invention. The adherents of the component-theories, who cannot yet rid themselves of the logical error that simplicity must be not only a useful principle for representation, but also a necessary factor for explanation, show a certain tendency to regard a threefold variability of light sensation as already too complicated. Hering, in order to account for the Phenomenon of Purkinje, introduces the "white-valence" as a property of color. But here, as on many other occasions, this excellent author confuses the psychical qualities of immediately given facts and the products of inferences drawn from other sources. If "white-valence" is a property of color-*sensation*, then we must be able to perceive it as something different from light-intensity, which is not the case. On the other hand, if "white-valence" is a physical property of light, like the energy of waves or the mode of polarization, then it does not stand in any direct relation to color-sensations, and cannot serve as a means of explanation for their relations.

I think those who still hold that it is possible to produce all variations of light-sensations by means of color-tone and light-intensity, can be persuaded of the erroneousness of their assumption by a single and decisive experiment. If we were

able to produce a surface which would have in all its parts the same color-tone and the same light-intensity, and yet show differences in its appearance, there could be no further objection raised to the introduction of the third variable of light-sensation, called saturation (or degree of color or intensity of color-tone). In the remainder of this paper we shall report a method by means of which such surfaces can be obtained.

Every light or color-sensation is simple, although the corresponding physical stimulus may be more or less complex. This is admitted even by adherents of the component theories. Müller, in his recently published article on the psychophysics of visual sensation, distinguishes fundamental and mixed-sensations, but declares both to be simple.[1] The saturation of a color-sensation depends (besides its

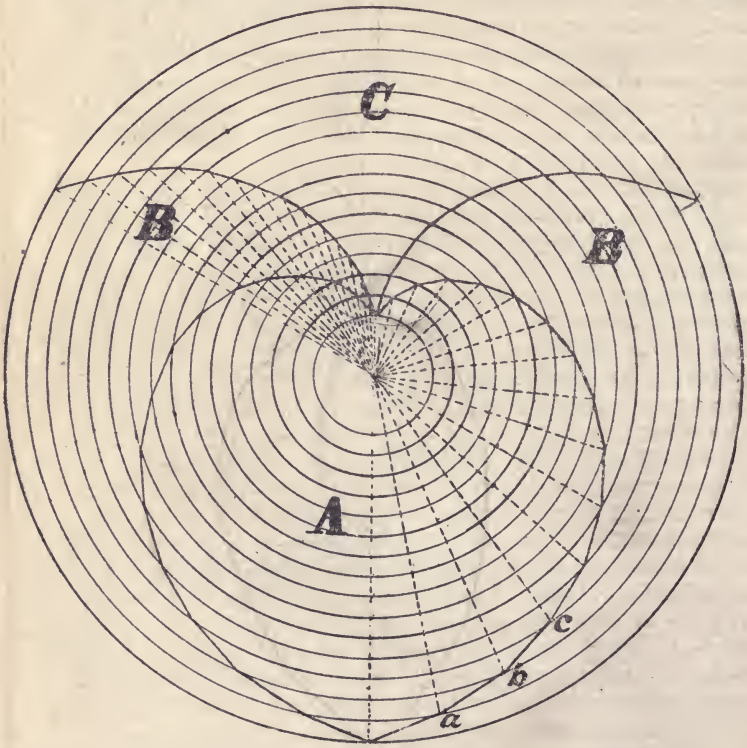


FIG. 2.

[1] *Zeitschrift für Psychologie und Physiologie der Sinnesorgane.* Vol. X, p. 34.

dependence on the constitution and disposition of the sense-organ, and on the co-existing contents of consciousness) on the composition of the physical stimulus. We have seen that "color" is produced by superposition of wave-lengths. The saturation of the color is the greater, the smaller the difference between the superposed wave-lengths is. The simplest way to diminish the saturation of a color is to mix it with colorless light. This can be easily done by means of rotating discs. In order to show on the same surface all transitions from the saturation zero of a color to the highest saturation, which we can obtain in pigment-colors, we have to construct a disc similar to that shown in Fig. 2.

Within a circle of the size of the desired disc, we draw a great number of concentric circles of gradually increasing radius and at equal distance from each other. Then we draw from the middle point and at equal angular distances just as many radii as we have concentric rings. In our figure we have fifteen rings; therefore we have to divide the angle of 180 degrees into fifteen equal parts, making thus the space between the radii each $= 12°$. If we then connect the points where the radii meet their corresponding circles (*i. e.*, the points where the first radius and the first circle, the second radius and the second circle intersect) by a curve and draw symmetrically to it on the other side of the diameter the same curve, we shall have the heart-shaped leaf *A* in Fig. 2. The curves so obtained divide the circles in such a way that the part of the circle which lies outside of the leaf is always proportional to the distance of that circle from the innermost one. In other words, the arcs inside of the leaf *A* decrease towards the periphery in an arithmetical progression, while the outside arcs beginning at the innermost circle increase in the same manner.

Now if we cut out of the colored paper a leaf of the form *A* in our figure, paste it on the gray, black or white disc and rotate the so prepared disc with sufficient speed, we shall see the fully saturated color in the centre and colorless light at the circumference, and between centre and circumference all transitions from one extreme to the other. On the other hand, if we cut the leaf out of white, black or gray paper and take a colored disc as the ground, this arrangement, when in rotation, will show the same transitions as above, but in inverted order, that is, the greatest saturation at the circumference, the minimum at the centre.

But with this method we do not arrive at pure saturation-degrees; there is always complication by the change of intensity. If we use black, we get all shades; if we apply white, all tints of the color concerned. If we wish to avoid

these complications by the application of gray, there remains the question: which of all possible grays between black and white must we take? In order to get rid of all differences of intensity, we ought to mix the color at every place of the disc with that gray which has exactly the same light intensity as the color itself. In order to accomplish this condition, we have first to ascertain the light-intensity of the color concerned. The photometry of colored light is not an easy matter; but there have been applied several methods which lead to satisfactory results. There is a very ingenious method devised by Prof. Rood.[1] Another way to find out the light intensity of colored surfaces the reader will find in my article on the quantitative relations of light and color-contrast.[2] Every determination of the brightness of a color is of course, on account of the Phenomenon of Purkinje, valid only for a certain constant intensity of the illumination.

Suppose we have by means of our photometrical method ascertained that for a certain intensity of the illumination, which we must keep constant, the color of the leaf A as regards its light-intensity is equal to a gray composed of x° white and 360—x° black. In order to mix this gray with all the different quantities of the color, we must divide the arcs outside of the leaf A (Fig. 2) according to the ratio $\frac{x}{360-x}$ (For our figure we have made the simple assumption that this fraction was $=\frac{1}{2}$.) By this procedure we separate the part C of the disc, and this part is to be covered with white, while the remaining part B must be covered with black. In our figure we have drawn only fifteen circles. If we use all the circles possible between the edge of the disc and that point from which we wish to start the change of saturation, the curves which limit the leaf and the white portion of the disc will be Archimedic spirals, which are for polar-coördinates what the straight line is for rectangular-coördinates. If we set the so constructed disc in rotation, we shall see the same color-tone and the same intensity on the whole surface, but the saturation decreases from the centre to the circumference in an arithmetical progression. We may briefly state the mathematical deduction of our curve.

The conditions to be satisfied are that the saturation starts at a certain distance d from the centre and decreases in such a way that the length of the radius r and the arc of the

[1] Rood, "On a Photometric Method which is Independent of Color." *American Journal of Science*, XLVI, Sept., 1893, p. 173.

[2] Kirschmann, "Ueber die quantitativen Verhältnisse des simultanen Helligkeits- und Farben-Contrastes." *Philos. Studien*, Vol. VI, p. 463 ff.

corresponding angular value of the color-component, ϕ, are inversely proportional; or:

When $r = d$, $\phi = 180°$;

" $r = a + d$, $\phi = 180 - a$;

" $r = na + d$, $\phi = 180 - na$;

from which follows the equation of the curve

$$\phi = 180 - (r - d)\frac{a}{a};$$

and if we put $\frac{a}{a} = \mu$,

$$\phi = 180 - (r - d)\mu \quad (1)$$

The value of μ is dependent on the size of the disc. If we wish to have the saturation 0 at the distance R from the centre, we must satisfy the special condition that

$$\phi = 0°, \; r = R.$$

The above stated equation (1) takes, then, the form

$$\mu (R - d) = 180,$$

$$\text{or } \mu = \frac{180}{R - d}.$$

If we substitute this value for μ in the equation of the curve, we have

$$\phi = 180 - \frac{r - d}{R - d} 180,$$

$$\text{or } \phi = 180 \left(1 - \frac{r - d}{R - d}\right) \quad (2)$$

We have to determine now the equation for the curve which divides the remainder of the disc into a white and a black part. Suppose the intensity of the color was equal to that of a gray composed of $n°$ white and $m°$ black. The ratio of the white sector to the whole surface left by the color, then, will be $\frac{n}{n+m}$. And since the angular value of the whole uncolored surface must at any distance from the centre be $180° - \phi$, the angular value of the white always will be

$$\text{White} = (180° - \phi)\frac{n}{n+m};$$

or if we substitute the above stated value for ϕ,

$$\frac{180\,(r-d)}{R-d} \cdot \frac{n}{n+m}. \quad (3)$$

In order to eliminate possible errors introduced by the spatial arrangement, it will be advisable to carry out each series of experiment with two discs, the one of the above stated arrangement, the other with the saturation increasing

from the centre to the periphery. In this case the equations, corresponding to the above stated (2) and (3), read as follows:

$$\phi = \frac{180\,(r-d)}{R-r},$$

and the angular value of the white sector, the width of which is now decreasing from the centre to the periphery, can be expressed thus:

$$180\,(1 - \tfrac{r-d}{R-d}) \cdot \tfrac{n}{m+n}.$$

In order to make the parts of the discs blend at a smaller speed of the rotation-apparatus, we need only to replace the coefficient 180 in the expressions by an aliquot part of it, *e. g.*, by 60. The construction is then carried out for every third instead of for the whole disc. The discs represented in Figs. 3 and 4 are obtained in this way.

These discs allow the application of the psychophysical methods to the quantitative investigation of color-saturation. We shall, however, confine ourselves in the following to the discussion of the circumstances under which we found the application of the method of average errors practicable and successful.

A disc of either kind described (Fig. 3 or 4) was rotated by an electromotor with a speed of about thirty turns per second. At a certain constant distance in front of the disc on a pedestal was fastened in a horizontal position a graduated circle, which carried a small telescope provided with a spirit-level. The telescope was movable in a horizontal and vertical direction, and its axis, when horizontal and in the position zero, pointed exactly at the centre of the disc. By means of the spirit-level purely azimuthal movements could be secured.

Attached to the telescope was a vernier, which permitted the reading to be made down to minutes. The vernier was a double one, connected at both sides of the telescope, so that every position could be ascertained by two readings. The lenses of the telescope were removed and the field of the instrument was so small that no differences of saturation could be detected within it. To the eye-piece was attached a small screen, which prevented the observer from seeing any other part of the disc except that surface which was shown through the telescope. In Fig. 5, which gives an illustration of the whole apparatus, this screen is not represented.

The method of our experiment was the following. The observer sees through the telescope, without knowing its position, a certain saturation, and after the position is changed, he is asked to find, by moving the telescope, the same saturation again. This can be sought, of course, on the same

side of the disc as the original position or on the opposite side. In effecting the re-adjustment the observer will make an error of greater or less magnitude. In a great number of single experiments these errors must be ascertained for a sufficient number of normal positions. And after being trigonometrically transformed from angular values into degrees of saturation, the results must be treated according to the method of average errors, with the end in view of testing the validity of Weber's law for saturation-quantities. Experiments of this nature have been performed during the past three academic years in the Psychological Laboratory of the University of Toronto. For the further details of this investigation, I beg to refer the reader to an article on this subject which will appear in a later number of this JOURNAL.

The apparatus above described could very well be used also for experiments on the validity of the psychophysical law for light intensities. The discs necessary for this purpose must consist simply of black and white. That the intensity of light-sensation does not increase proportionally to the quantity of the stimulus, can be directly demonstrated by the appearance of these discs when in rotation. For no matter whether the white forms the leaf or the ground, the disc never makes the impression of a uniform or arithmetical transition between the two extremes; it always looks too white. If the ground is white, the disc seems to be white, with a darker spot in the centre. If the leaf is white, the periphery only seems to be of considerable darkness. In the former case the medium gray is too near the centre, in the latter too near the circumference. This state of affairs suggests the construction of a disc, where the increase or decrease of intensity follows exactly the law of Weber. In this case the outlines of the trifolium, referred to polar coördinates, are transcendental curves analogous to logarithmic curves in ordinary rectangular coördinates. In the following we may give the simple deduction of the equation for the curves concerned.

If we wish to have an increase of the intensity in a geometrical progression from the centre to the circumference, the following conditions have to be satisfied:

$$\text{When } r = a,\ \phi = a;$$
$$\text{when } r = na,\ \phi = a^n;$$

$$\text{from which follows that } \phi = a^{\frac{r}{a}}, \quad (1)$$

$$\text{or } r = a\frac{\log \phi.}{\log a} \quad (2)$$

In order to take into account the desired size of the disc,

i. e., in order to give ϕ a determined value X at a certain distance from the centre, we have to satisfy the condition that

$$r = R, \text{ when } \varphi = X,$$

where R is the desired radius of the disc.

We have, then, $X = a^{\frac{R}{a}}$,

$$\text{or } \log X = \frac{R \log a}{a},$$

$$\text{from which follows } \frac{a}{\log a} = \frac{R}{\log X}.$$

If we substitute this value for $\frac{a}{\log a}$ in the equations (1) and (2), we obtain

$$r = \frac{R \log \phi}{\log X},$$

$$\text{and } \phi = \sqrt[R]{X}. \quad (3)$$

If, on the other hand, a decrease of intensity from the centre is desired, a deduction similar to that above stated leads from the condition: when $r = na$, $\varphi = \sqrt[n]{a}$ to the equation

$$\phi = \sqrt[r]{X^R}, \quad (4)$$

where R denotes, as above, the radius of the disc and X the desired angular value of the white at the circumference.

Fig. 7 shows schematically the geometrical construction of the curve for formula (3), *i. e.*, for a disc with intensity increasing from the centre. A denotes the black, B the white part. Fig. 6 represents two discs of this kind as they are actually used in the laboratory. For the sake of an easier blending of the components, the construction is also made here for every third of the circle. In Fig. 6 *a* the intensity increases from centre to periphery; in Fig. 6 *b* a decrease of intensity from centre to circumference takes place. Both discs, when in rotation, present to the eye a surface with apparently uniform transition from black to white. They make, to a very satisfactory degree, the impression of an arithmetical increase of intensity, and form thus an excellent means of demonstrating in a lecture in a very brief and simple manner the significance of the psychophysical law. The original curve for Fig. 6 *b* will coincide with the construction which Delbœuf gives as *construction d'une echelle des sensations.*[1]

In the above given deduction of the equations, we have

[1] J. Delbœuf, "*Etude psychophysique*," p. 92.

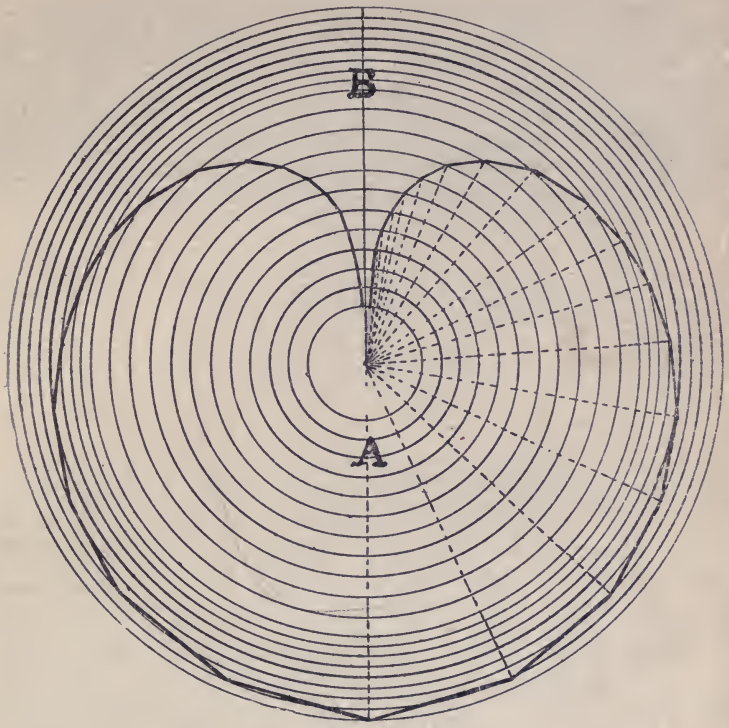


FIG. 7.

assumed that the intensity of the black was zero. This is practically only approximately secured when the black parts of the disc are made of good black velvet, or when the white parts are freely rotating before an open, completely dark space. As soon as we use material of measurable reflecting power, as, *e. g.*, black paper or lamp-black, etc., we must no longer neglect its intensity. If the reflection of the black is to that of the white as 1 is to k, the general expression for the condition, which must be satisfied at each point of the disc, is :

$$\text{When } r = na,\ k\,\phi + (180 - \phi) = \alpha^n,$$
$$\text{or } \phi\,(k-1) + 180 = \alpha^n,$$

which, treated as in the simpler case above, leads to the equation

$$\phi\,(k-1) + 180 = \sqrt[R]{[X\,(k-1) + 180]^r},$$

$$\text{or } \phi = \frac{\sqrt[R]{[X\,(k-1) + 180]^r} - 180.}{k-1}$$

It may be mentioned that, by means of both kinds of discs, namely, those with the arithmetical and those with the logarithmic order of intensities, experiments are being carried on in our laboratory, which will be reported later. It will be easily seen that the logarithmic arrangement can just as well be applied to colored discs. The curves which separate the white and black on the uncolored part will then also be curves of the nature represented by equations (3) and (4).

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF WELLESLEY COLLEGE.

Communicated by MARY WHITON CALKINS.

III.—A STUDY OF THE DREAM-CONSCIOUSNESS.

By SARAH C. WEED and FLORENCE M. HALLAM, with the assistance of EMMA D. PHINNEY.

This paper presents the results of a study, by the writers, of their own dreams and of the dream-records of four fellow students.[1] The observations followed the general plan outlined by Miss Calkins,[2] and this description of them lays special stress only on experiences which confirm her conclusions on disputed points or which contradict her results. The dreams were recorded during periods of six and five weeks, and numbered 141, 150 and 50 respectively. The smallest number is probably due to the fact that the subject, unlike the others, found it impossible to record the dreams immediately upon waking, so that her records were made in the morning, when many dreams had been forgotten.

Both *W.* and *H.*, who record the time of their dreams, find that half of them occur before 4 A. M. The proportion of night dreams is thus much larger than in the case of the earlier observers, and definitely substantiates their assertion that "the sleep of the middle of the night is in no sense a dreamless sleep." The influence of the time upon the number and character of *W.*'s dreams is of interest. Only one-tenth of them occurred before midnight; these were all of a probable nature, not vivid, and therefore hard to recall. Those from 1 to 4 A. M. were more frequent and more vivid, but still of the probable variety, including among them only one absurd or fantastic dream. The dreams occurring from 5 to 6.30 are the most frequent, most interesting, most vivid and most varied. A possible explanation of this may be found in the greater morning freshness of the mind, but it is also likely that the recall of the morning dreams is easier and more detailed. The conclusion of another subject is closely allied with this. "In every case," she says, "where distinct thought has occurred in dreams, it has been in those during the morning sleep." She adds the reminder that these morning dreams are those best recalled, so that it is always possible that reasoning has been present in night-dreams and then has been forgotten.

The dreams occurring at odd moments are also of an interesting

[1] To two of these, Miss Mary Coleman Adams and Miss Mabel W. Lees, special thanks are due for very full records and for many valuable suggestions.

[2] "A Statistical Study of Dreams." AMERICAN JOURNAL PSYCHOLGY, Vol. V, p. 312.

nature. They are the results of momentary drowsiness in church and in the class-room, or of short naps taken during the day. Of the eleven recorded, all are of a highly probable nature. An experience resembling this, and yet distinct from it, is that of another subject, who writes of her "waking dreams." "Often," she says, "when I am awake I pass into a state resembling sleep, in which I lose control of my imagination, but keep my powers of perception and reasoning. I dream before I go to sleep, and the way I have proved this is by opening my eyes, looking around the room, turning over in bed, closing my eyes again, and taking up the dream where I left off. Very often I am able to finish a dream in this way when I have been waked in the middle of it." Waking dreams of this sort, like hypnagogic images, indicate the unity which underlies all the distinctions of waking and dreaming life.

As in the case of the earlier observers, the occurrence of the presentation (the consciousness within the dream of actual, external stimuli) has been relatively infrequent, but *H.* reports 20 dreams (of 150) which were caused by external stimuli, and 13 instances in which a presentation is taken up into a dream already "under way." In nearly one-third of these dreams the presentation is experimentally induced. The subject places flowers or onions by her bedside, and dreams of smelling and tasting; or she eats salt just before going to sleep, and dreams of a thirsty drive through a wilderness. Or she is the victim of certain mild experiments: her face is sprinkled with water and she dreams of a rain storm; a paper bag is burst near her ear and she dreams of hearing shots fired. The converse effect of the dream upon the waking experience is observed in one-tenth of *H.*'s dreams. She wakes tired and lame after a dream of running; she smells and tastes onions after dreaming that she eats them; repeatedly she wakes herself by a real cry of terror at some dream-apparition.

But with *H.* as with the others, dream-imagery occurs far more often than dream-perception. Its different types have been closely observed, since it is so often claimed that only visual and auditory images occur in dreams. These records, like the earlier ones,[1] distinctly contradict this assertion. Visual images predominate, so that, for instance, visualization occurs in each of *W.*'s dreams, and auditory images, especially verbal ones, are next in number; but dermal, gustatory and olfactory experiences certainly occur in the dreams of the writers and of others. In the dreams of one of us the sense-images are present in their natural combination as in the waking life. The presence of sight, hearing, smell, taste and pressure is shown in *Dream 2*, *W.*: "I seem to be in a beautiful wood, where sunlight and shadows lie under the pines. A fragrant odor fills the air, and the wind, as it blows among the trees, seems to sing a song. . . . . I lie under the trees, while the low branches come brushing down over my face, and I feel the pressure of the mossy bank beneath me. A branch brushes low over my face; I break it and bite the pine needles, noticing their flavor. . . ."

Several taste-images of great vividness have occurred among the number recorded. An example illustrating both smell and taste-images is a dream recorded by *H.*, on a night when she had taken special precautions against objective tastes by washing out her mouth before retiring: "(*Dream 55*, 1 A. M.) When we came down to breakfast, there were only onions on the table. Every one

[1] *Op. cit.*, AMERICAN JOURNAL of PSYCHOLOGY, V, p. 321.

seemed to be eating them and enjoying them, so I ate some and liked the taste, but the odor was very disagreeable."

These instances, with others recorded in Table III, in which taste *images* and not "real" tastes were concerned, reinforce the cases collected by Dr. Titchener,[1] and show the improbability of any theory [2] according to which brain-centres of taste are excitable only through peripheral stimulation. Olfactory dream-images have been noticed by four observers, in some cases as very vivid—the odor of heavily scented flowers or of burning cloth—but sometimes as a faint and pleasant fragrance. All these characteristics are summarized in

TABLE I. DREAMS CONTAINING REPRESENTED SENSE-ELEMENTS.

SUBJECTS.	SENSE-IMAGES.				
	Visual.	Auditory.	Dermal.	Gustatory.	Olfactory.
W. (141).....	141 (100. %)	127 (90. %)	19 (13.5%)	17 (12. %)	21 (15. %)
H. (150).....	109 (72.7%)	82 (54.6%)	9 (6. %)	4 (2.7%)	4 (2.7%)
P. (50).....	46 (92. %)	35 (70. %)	9 (18. %)	2 (4. %)	1 (2. %)
Others (40)...	36 (90. %)	18 (45. %)	4 (10. %)	1 (2.5%)	0
Total, 381	322 (84.5%)	262 (68.7%)	41 (10.8%)	24 (6.3%)	26 (6.9%)

Excluding, of course, the mere presence of the imagination, in which the dream-consciousness consists, many cases of explicit imagination occur in these dreams in which the mind has, as it were, run forward to picture some probable result or to discover some way out of a difficulty. So one dreamer, proposing to mend the tire of a bicycle with black silk tissue, "imagined very clearly how strange the gray tire would look if I put that black band around it." Memory also is a frequent or an occasional factor and sometimes is of events within the dream, as when (dreamer *W.*) "I get aboard the street car and go for a few blocks, when I remember that I left a package lying on one of the counters of the store which I just left." At other times the memory is of actual events of the waking life. So one or two long but accurate dream computations, by one of the writers, were helped by the memory that on certain dates, certain things had happened. The presence of memory within dreams suggests the memory of one dream from another, which is allied with the inter-connection of hypnotic states, and whose common form is the recurring dream. All but one of our subjects have dreams of this sort; and of twenty-five people questioned nineteen testified to some such experience. In some cases the dreams form a sort of "continued dream." Paramnesia, of course, is common.

[1] AMERICAN JOURNAL OF PSYCHOLOGY, VI, p. 507, seq.

[2] Cf. J. C. Murray, "Proceedings of the American Psychological Association," 1892.

Explicit thinking and reasoning have occurred so certainly in the dreams of all the subjects that it is possible to deny dogmatically the frequent statement that dreams are characterized by the entire absence of thought. The reasoning of dreams may be incorrect, but is often accurate. A general tendency, especially noted by one of the writers, is to account for the unusual and unexpected improbabilities of the dream. Here we have dream-reasoning pitted, as it were, against dream imagination: the dream-images, though recognized as unusual, are accepted as objective and actual, but brought into unity with the waking experience by some sort of explanation.[1] The following dream, for instance, shows very acute reasoning under somewhat improbable circumstances: *Dream 15* (The subject was waked by the rising bell, but fell asleep again.) "The devil came and suggested that he would change my self-consciousness, making me over into a person with no pressing duties, then allowing me to sleep as late as I wished without interference of conscience. I recognized that the suggestion was from the devil, and after considering the matter decided that I would not accept the offer, since the devil would probably cheat me." Another case of reasoning reflects the every-day study, and applies it in a very practical way: "(*Dream 119. H.* 6 A. M.) We were going for a long drive, but just before the time of starting it began to rain very hard. I said to my friend, 'I am a stoic, therefore I cannot be disappointed nor unhappy, therefore I do not care whether it rains or not; I am perfectly neutral, and if you were a stoic you would feel the same.'"

All save one of these dreamers have had dreams including choice, usually involving cases of conscience and more or less prolonged reasoning. One of them is required in a dream to make a dissection for which directions are written in Greek (*Dream 13, P.*): "I was in distress because my instruments would not work, and I had forgotten what I knew of the Greek. I reasoned with myself about the honesty of having some one translate the directions. After much thought I decided that I would not have the directions translated, because the work was to be individual . . . . and this would be deceiving."

More than half (57.2%) of the 381 dreams considered are said by the subjects to contain "disagreeable" emotions, but more than one-fourth (28.6%) are pronounced pleasant, a result which differs greatly from that of the earlier records. In these pleasurable dreams are hardly discovered, the number of emotional dreams is much smaller (only 21.3% of 375 dreams) and of these only one-fiftieth (2.4%) are pleasant, while more than one-sixth (17.6%) are painful or disagreeable. The divergence of individual experience is strongly marked at precisely this point. To two of our subjects dreams are preëminently a source of pleasure. One of the writers records 72 of 141 dreams as distinctly pleasant, though there have also been vivid dreams in which pain has been keenly felt. Another says, "I look forward with delight to my hours of sleep." Still a third observes that on the whole dreaming is a very pleasant experience, but that in these dreams the disagreeable predominates. This suggests, of course, either that the ordinary impression is a careless one, or that the dream study brings about an abnormal emotional disposition. The classification is difficult in any case, for the emotions during the dream

[1] Cf. *Op. cit.*, AMER. JOURNAL. V., 339.

and immediately after waking from it are often entirely different from those suggested by reading its record.

These results are summarized in the following table:

TABLE II. EMOTION IN DREAMS.

Dreams[1] are.....	NAMES OF SUBJECTS. W. (141).[1]	H. (150).	P. (50).	Others (40)	(Total 381).
"Pleasant"..	72 (51.00%)	19 (12.6%)	9 (18%)	10 (25%)	110 (28.6%)
"Neutral". .		15 (10.0%)	4 (8%)	4 (10%)	23 (6.0%)
"Disagreeable".....	70 (49.64%)	99 (66.0%)	23 (46%)	26 (65%)	218 (57.2%)
Total Cases Emotion...	142 (100.00%)	133 (88.6%)	36 (72%)	40 (100%)	351 (92.1%)

Perplexity and hurry, discomfort and helplessness, fear, anger, disappointment and shame are the chief unpleasant emotions in the order of their prominence. On the other hand, æsthetic enjoyment, of which Miss Calkins found no trace in the dreams which she studied, has been a relatively frequent experience with these dreamers, though one of the writers observes that the beautiful turns into the horrible or the absurd in almost every instance. A dream of the beautiful is, for instance, the following: "(*Dream 48, H.*, 3 A. M.) I went into the garden and there were all the roses beginning to open. A little bluebell rang out and the roses began slowly to unfold. The garden was a perfect bower of beauty; every rose on every bush was opened, the bluebells were all ringing, the other flowers all opened, the birds began to sing."

The existence of some connection between the dream world and the waking world, that is, the suggestion of the dream by some actual experience, is traced in most of the dreams. *H.*, however, finds this connection only in half the dreams, but adds, "I think that many of mine might be traced to things . . . . forgotten." The exact relation, however, differs with different individuals, as is shown by an analysis of the dreams. The figures representing the dream-characters are not reduced to tabular form, because of the difficulty of dealing with cases where people appeared in crowds — as in church or in class — but the *locale* of the dreams is indicated by the following summary:

[1] The percents. are calculated on the totals at the head of the vertical columns, so that the percents. represent the proportions of each subject's dreams and of the total number, which are "pleasurable," "neutral" and "disagreeable." The term "neutral" is applied chiefly to feelings of surprise and wonder.

TABLE III. DREAM SITUATIONS.

	Distant.	Near.	Unknown	Total.
W.....	68 (41.0%)[1]	53 (32.0%)	45	166[1]
H.....	34 (22.7%)	81 (54.0%)	35	150
P.....	39 (71.0%)	12 (22.0%)	4	55
Others.....	6 (17.1%)	19 (54.3%)	10	35
Total.....	147 (36.0%)	165 (40.0%)	94	406

These totals show that the larger number of dream situations belong to the present. There are, however, marked individual differences, amounting in the case of *P.* to a preponderance of the absent and the distant in her dreams. The most striking divergence of these results from those of the earlier investigation, relates to dreams of the dead,[2] of which several appeared in each record. One of the writers dreamed constantly of a relative during the months immediately following her death, years ago, and has dreamed often of a member of her family during the year which has passed since his death. Another says: "Since the death of a very dear relative about a year ago, I have constantly dreamed of him; only once have I dreamed of his being dead—all the other times he has been in circumstances of ordinary life. Our relations have been peculiarly pleasant, and often it has seemed as if he commended me for some things I had done. When I began to record my dreams, I wrote down one or two of this nature, and then they suddenly stopped. Not wishing to give up this experience, I no longer recorded dreams, and after two or three nights these dreams began again; they are always pleasant and sometimes the presence of my friend seems to be with me, even when I have no distinct dream." While therefore accepting, as a general rule, the assertion that the dream world is most closely bound to the life of the here and the now; and that its people, its places and its events are unconnected with the most significant phases of the waking life, the freest exceptions must be made in deference to the lawless caprice of dream association and to the unexplored differences of individual temperament.

On still another point these records differ materially from the earlier results. *W.'s* dreams are the only ones which include a majority (95 cases, that is, 69%) of probable dreams. Four-fifths of *H.'s* dreams and nine-tenths of *P.'s* (115 and 47 cases) and three-fourths of the rest are rated as improbable or as impossible, that is, as fantastic or absurd or horrible. Of *W.'s* probable dreams some, however, have been so vivid that she says of them "in one or two instances they have been [later] mistaken during a short time for the actual."

The dream-illusion has not often assumed the form of an entire change of personality. Sixteen such cases occur; in all but one of these, as in the similar cases reported by Miss Calkins, the change is mainly of the physical personality, and does not affect the consciousness of self-identity. So *H.* dreamed several times

[1] The percents. in this table are calculated on the totals in the right-hand vertical column, each representing the entire number of dream places of one subject.

[2] *Op., cit.*, p. 333.

of growing smaller and becoming her child self. Once when she "changed into" a fellow-student, she thought it strange "that the teacher did not know that I was doing all the reciting" —an expression which clearly shows how the real *I* was watching over the assumed personality. In one dream, however, there is at least a close approach to what is called loss of personal identity. (Dreamer *W.*) "I seem to be an old minister, lean, tall, with long, thin white hair. My coat is a long Prince Albert, worn at the elbow; my tie is black. I realize that I am soon to die. I review my whole career as a pastor, call to mind several people and some of the details of the work. I think of some of the sermons I have preached and feel a strong sense of my shortcomings." The writer adds: "In this entire dream I do not view the personality which I have assumed as one apart, but as one from within. I do not see the long, gray hair and the black tie, but imagine them as one imagines any bodily characteristic or any article of dress not in direct vision."

The dream experience of *H.* includes repeated occurrences of the "veridical" dream. Most of these relate to unimportant happenings: a drive is dreamed the day before it is taken, and the muddy places in the road are accurately foreseen, or an unannounced examination occurs in a dream of the preceding night. Occasionally, however, these dreams are precursors of more significant events, as when a dream-letter announcing illness is followed by an actual letter of the same sort, and as when a death which later really occurs is announced in a dream.

The dreams which have been recorded as a basis for this study are, in fact, generally richer and more significant than those of the earlier observers.[1] The chief result of the investigation is therefore the emphasis which it lays upon the individuality of the dreamer and upon the consequent impossibility of all dogmatic generalizations about the rules and fashions of dreaming. Most of the traditional limitations of the dream-consciousness, like the denial of thought and volition and of taste and smell images, are definitely contradicted on the testimony of all these observers. The continuity, also, of the dream life with the waking life is shown, and there are suggestions of the likeness of the dream-consciousness to the hypnotic condition.

[1] AMERICAN JOURNAL OF PSYCHOLOGY, *op. cit.*, p. 332.

A LABORATORY COURSE IN PHYSIOLOGICAL PSYCHOLOGY.

By EDMUND C. SANFORD.

Sixth Paper.

MONOCULAR PERCEPTION OF SPACE.[1]

170. The Retinal Image and Perception of Size. Accuracy of Discrimination.

The perception of size is commonly complicated with that of distance. When, however, objects are at the same distance, their apparent size will depend on the relative size of their retinal images, if the eye is at rest, or on that and the extent of the angles through which the eye must be moved to sweep over them, if it is in motion.[2]

a. Accuracy of Comparison with the Eyes at Rest. Test with Galton's bar and the krypteon[3] as follows: Place upon the middle of the flap of the instrument a small point to serve as a fixation point, and a guide mark on the back board to help in placing the bar so that its division thread may be each time exactly behind the mark on the flap. Adjust the Galton bar so that its division thread is in the middle. Place it in the krypteon and cover it with the flap. Let the subject fixate the point on the flap, and when he is quite ready let him quickly turn down the flap, and, keeping his eyes unmoved, make his judgment as to the equality of the two parts of the bar. If the parts seem unequal a constant error in his judgment is probable. Record the judgment, remove the bar and alter the setting slightly. Replace the bar as before, with the division thread behind the fixation mark, and require a new judgment. Repeat this process, gradually increasing the displacement until the subject is just able to recognize a difference in the parts of the bar. Record the difference of length required for this judgment and continue the experiment, beginning this time, however, with the parts quite distinctly unequal and working gradually toward equality.

A number of determinations should be made when the thread is displaced toward the right and toward the left and with changes towards equality and away from it—an equal number of each kind—and the average of all taken. The ratio of the just observable difference to the length of one part of the bar is the measure of the accuracy of discrimination required. Averaging the results separately for the cases in which the thread was displaced towards the right and towards the left, will show the constant error in judgment if there is any. It might seem profit-

[1] Continued from Vol. VI, 593-616, to which the reader is referred for introductory matter.

[2] The size of the retinal image is found, as explained in Ex. 112, JOURNAL, IV, 484, by drawing lines from the extreme points of the object through the Crossing Point of the Lines of Direction and prolonging them to the retina. The angle made by these lines is often called the *Visual Angle*. This construction, however, is exact only when the eye is exactly accommodated. When the eyes are not accommodated, the Sighting Lines form the angle instead of the Lines of Direction. And when objects are seen by sweeping the eye over them from end to end, the lines which give the true Visual Angle are obviously those from the extremities of the object to the centre of rotation of the eye. These various kinds of Visual Angles differ but slightly among themselves, and as a matter of fact are all purely artificial. Immediate perception knows nothing of Visual Angles, or for that matter of retinal images, but only of things seen.

[3] For description of these instruments see section on apparatus at the close of the article.

able to furnish the subject with a head-rest in order to secure a constant distance between his eyes and the bar, but there is reason to think this relatively unimportant (v. Kries, p. 187), and at all events it is not necessary for casual testing. The movements of the eyes from end to end of the bar are more important, but with care on the part of the subject, there should be no difficulty in keeping the eyes from serious movement. Of course any trials in which such occur should be reported and excluded from the record. If more perfect exclusion of eye-movements is desired, it may be obtained by placing the bar in a dark box and using flash illumination.

b. Repeat the experiment with all conditions as in *a*, except that after the showing of the bar the subject be allowed to move his eyes freely in comparing the parts. Compare the results found in *a* and *b*.

Wundt, *A*, 3te Aufl., II, 116 ff., 4te Aufl., II, 132 ff.; Helmholtz, 682 ff.; F. 695 ff. (541 ff.); Münsterberg; and the literature cited by them. For measurements of a similar kind made upon squares see Warren and Shaw (p. 240); for such measurements on circles and effect of color on size, see Quantz.[1]

171. The Retinal Image and the Perception of Size: Ordinary Seeing. In the absence of other determining circumstances, large retinal images are taken to belong to large objects and small to small. Undetermined cases are, however, extremely rare.

a. Known objects are generally Perceived as of a Constant Size Irrespective of the Size of their Retinal Images. Hold the hand eight inches from the face and notice its size; then move it to sixteen inches and observe that its apparent size remains the same, despite the fact that its retinal image has now only one-half its former length and only one-quarter its area. On further removal to twenty-four inches, the apparent size is still the same. This constancy is found in estimating the height of men, domestic animals, and familiar objects generally. This fact is frequently made use of by painters, who introduce the figures of men and other well-known objects to suggest indirectly the size of objects near which they are placed.

In somewhat the same way a well-known tower or tree may serve as a measure for the disk of the sun or moon rising behind it, with the result that these seem larger than when such comparison is impossible. This, however, is by no means the only element in the illusion. The flattened form of the sky—itself the resultant of several causes—also coöperates in making the sun or moon at the horizon seem further away and therefore larger. The matter may be followed further in Helmholtz; Wundt, *A*; Filehne; and in a discussion by Lechalas and others in the *Revue Philosophique*, Juillet, 1888—Février, 1889.

b. When the objects are equally familiar, an important part is played by attention in determining which shall be taken as the measure of the other. This is easily shown with two fingers, one held at eight, the other at twenty-four inches. Steady looking at the farther finger makes the nearer look larger than normal, and staring at the nearer makes the farther look smaller.

c. Another experiment which shows the same independence of the retinal image is cited by Helmholtz from Smith's "Opticks" (published 1738). Place in the focus of a convex lens a wafer, a printed letter or any other small object, and view it at different distances from the lens. As the distance increases, the object will seem to enlarge until it fills the lens completely. The fact is, however, that its image remains approximately constant in size (since the rays from it are made parallel by the lens), while

[1]For full titles see Bibliography at the end of the article.

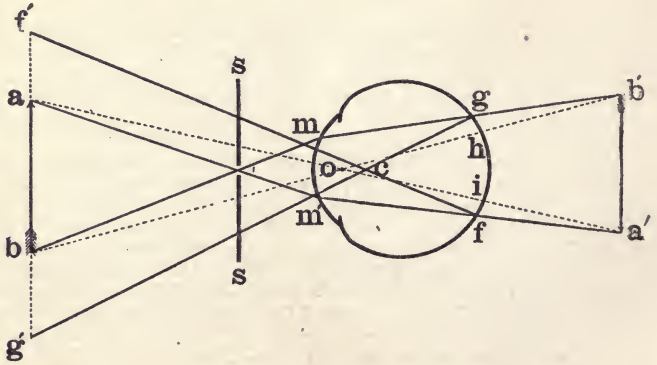
the image of the lens itself and of all other objects in the visual field decreases in size. For experiments on the exactness with which extents can be compared when their distance from the eye is unequal and when their visual angles both for the eye at rest and in motion are thus unequal, see Fechner, II, 312 f.; Martius; v. Kries, 187 ff.

Hering, 14 f.; Helmholtz, 839, F. 871 (689).

172. The Retinal Image and Perceptions of Size and Distance. A circumstance that very frequently determines the apparent size of an object is its apparent distance; or, more generally, size and distance are mutually determining. If the apparent distance is constant, the apparent size of the object changes directly with the size of the retinal image; while if the apparent size is constant the apparent distance changes inversely with the image. These are facts of very common observation. In the laboratory they may be demonstrated as follows. Look at a portion of a page of print through an ordinary magnifying glass, holding the glass near the page so that a good deal of the latter can be seen outside the lens. The retinal image of the part seen through the lens is enlarged, but the parts of the page seen outside the lens fix the distance for the whole, so that the letters seem enlarged. On the contrary, when an opera glass or a telescope is used for a distant object, the eye is brought so close to the eye-piece that nearly all the visual field, except that seen through the instrument, is cut off. The result is, then, that objects appear nearer, and but little if any larger. The effect is equally clear when the retinal images are reduced by using a double concave lens in the first case and by looking through the opera glasses from the big end in the second. See also an experiment of Hillebrand's, p. 121 f.

a. Some interesting changes in the size of the retinal image may be produced with a pierced card. Look through a fine pin-hole in a card, held as close as possible to the eye, at a printed page held an inch or two further away. The type will seem much magnified, larger even than the blurred image of it seen when the card is removed entirely. Cf. the enlarged shadow in Le Cat's Experiment (Ex. 156; JOURNAL, VI, 594). When the card is gradually moved farther from the eye and nearer the paper, the print seems still larger. A strong light on the page increases the ease of the experiment.

The understanding of this phenomenon will be assisted by the following diagram from Helmholtz:



In the usual condition of vision, objects at a distance of one or two inches appear much blurred, because the eye cannot be accommodated for them; the retinal image is made up of overlapping diffusion circles, which depend in part for their size on the size of the pupil. In the diagram the lines *ai* and *bh*, drawn through the crossing point of sighting lines o, touch the retina at the centres of the two circles, of diffusion representing the tips of the arrow *ab*. The intermediate points of the arrow are of course represented by circles whose centres lie between *h* and *i*. When an object is thus seen in diffusion circles, it is not taken to be of a size corresponding to the full extent of the circles, but only to the central portion of the blur. The apparent extent of the arrow as seen without the card would therefore correspond to a retinal extent not much exceeding *hi*. The introduction of the card (*SS*) with its minute opening, reduces the diffusion circles till they are hardly visible, and the blur is cleared up. The little cone of rays passing through the pin-hole from *a* reaches the eye at *m'*, and is refracted by the cornea and lens and strikes the retina at *f*. In the same way that from *b* goes to *m* and is refracted to *g*, the intermediate points of the arrow being represented as before, on intermediate retinal points. It is evident that with the pierced card the retinal surface illuminated is larger than without it ($fg > hi$), and when the image is referred outward, as usual, along the lines of direction (see Exs. 101 and 112, JOURNAL, IV, 478, 484), here *ff'* and *gg'*, the ends of the arrow will seem to lie at *f'* and *g'*, and the whole will appear enlarged. It is clear also that moving the pierced card toward the object must increase the separation of the points *m'* and *m*, and consequently of *f* and *g*. Cf. also Ex. 173.

Helmholtz, 118 f.; F. 126 f. (96 f.).

173. Perception of Depth by Means of Accommodation. Changes in accommodation produce changes in the retinal image, which certainly influence the perception of distance. Whether the direct muscular effort of accommodation has any such effect, apart from changes of the retinal image, has been questioned. Experiments have been made on the matter by Wundt (*A*, 3te Aufl., II, 92 f., 4te Aufl., II, 107; *B*, 105 ff.), by Hillebrand and by Dixon. The differences of accommodation that are required for securing sharp images of objects at the same distance, but differently colored (due to the chromatic aberration of the eye), have been held to have an effect on the apparent distance of colored objects. Experiments on this point have been made by Silvanus P. Thompson, but his results are hard to verify. The whole problem, indeed, both as to judgments depending on normal accommodation and on that required by chromatic aberration, is still *sub judice*, and will not be followed further here.

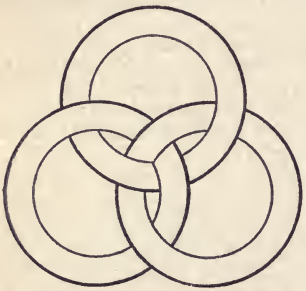
The indirect effects of accommodation have long been known, but apparently little studied. If, while attention is given to a distant object, *e. g.*, a house or tree, the eye is suddenly accommodated for a near point, the distant object will appear to withdraw and diminish in size. If the operator is not able to accommodate voluntarily, the experiment may easily be made by letting him stand close to the window and select a spot on the glass for a point of near fixation. A slight variation of the experiment with the pierced card just discussed (Ex. 172 *b*) shows the same result, heightened, perhaps, by other coöperating causes. Repeat Ex. 172 *b*, this time looking at a distant object. Accommodating for near vision now makes the object appear smaller and further away, and carrying the card toward the object produces still further diminu-

tion in size. The effect appears to be due to an actual reduction in the size of the retinal image, and can be imitated with a suitable arrangement of lenses and screens. The apparent size of the object appears also to decrease with decrease of the aperture in the card. For other changes following accommodation, see Scheiner's Experiment, Ex. 101, JOURNAL, IV, 477.

Helmholtz, 119; F. 127 (97); Walker.

174. Monocular Perception of Depth by Means of Intervening Objects.

a. Several of the monocular means of perceiving the relative distance of objects are better observed in the casual use of the eyes than in specific laboratory experiments, and this among the rest. The following figures, however, show something of the tendency. We are more inclined to regard the rings in Fig. *A* as complete and passing behind one another than as broken and carefully laid together. In the second figure the effect is still stronger, because it is still more difficult to conceive the arch in the same plane with the column and fitting exactly into its irregular contour.



A

B

The multitude of objects intervening between the eye and the horizon, together with their known size and distances, doubtless contributes also to the flattened appearance of the dome of the sky.

b. In the following experiment the inference of intervening objects combines with the customary location of mirror-images behind the mirror surface to produce a false location of the image thrown by a concave mirror. At a distance in front of a concave mirror, somewhat less than double its focal distance, is set up a figure like that below, cut from cardboard and blackened on both sides, or even an ordinary retort ring of small size. The observer takes his position still further from the mirror in the line passing through its centre and the centre of the ring, and, if the adjustments are correct, sees floating in the air, a few inches in front of the actual figure, an enlarged and inverted image of it—so long, at least, as he observes with both eyes. The instant, however, that he looks with a single eye, the image drops back to the mirror surface or beyond. The rays of the figure and the spots on the mirror, which are seen through the floating image, and the frame of the mirror, which cuts the image off at the sides, all conspire, when the binocular means of location are wanting, to make the image seem behind instead of in front.

The dimensions of the mirror and the setting with which the writer has repeated the experiment, are as follows: Diameter of mirror, 10 cm.; Focal length, 25 cm.; Distance of the rayed figure from the mirror, 40 cm.; Inner diameter of the ring of the figure, 27 mm., outer 33 mm., length of rays, 27 mm.; Distance of the observer from the mirror, 3 m.

If the observer has difficulty in getting the binocular location, a little swaying of the head from side to side, which causes the image to shift with reference to the mirror and the figure, may be helpful.

A similar experiment may be made with suitably adjusted convex lens.

a. Helmholtz, 768, F. 793 (624); Sully, 80 f.
b. Helmholtz, 769, F. 793 (624 f.).

175. Perception of Relief by Means of Shadows.

a. The effect of shadows is finely shown by a mask colored alike within and without.[1] Place the mask, with the hollow side toward the observer, in such a position that the light falls full upon it and no shadows are cast inside it. Let the observer regard it with a single eye from a distance of six or eight yards. He will find it difficult, or even impossible, to see the mask in its true concave condition; preponderant experience apparently dictating the opposite result in perception. If, however, the position of the mask is so changed that the light falls into the mask obliquely, the shadows immediately betray the concavity, and no difficulty is found, except, perhaps, with the nose (which lies wholly in the shadow), in seeing the thing as it is.

Medallions with heads in low relief, when lighted equally from all sides, can with some effort be seen either convex or concave—cameo or intaglio. The presence of unequal illumination and cross shadows makes this more difficult. A sheet of paper folded like a half open book and set up vertically, shows somewhat the same effect, especially if the lower end is covered so that its contact with the table cannot be seen. Cf. Fig. *N*, Ex. 176 *b*.

b. Einthoven's Experiment. In the following experiment dark borders resembling shadows lead to an illusion of elevation on depression. Cut a piece of cardboard eight inches long by four wide; cover half of it smoothly with red paper and half with blue. On the red paper paste several strips of blue, and on the blue several strips of red, strips a quarter of an inch wide by two long,—or

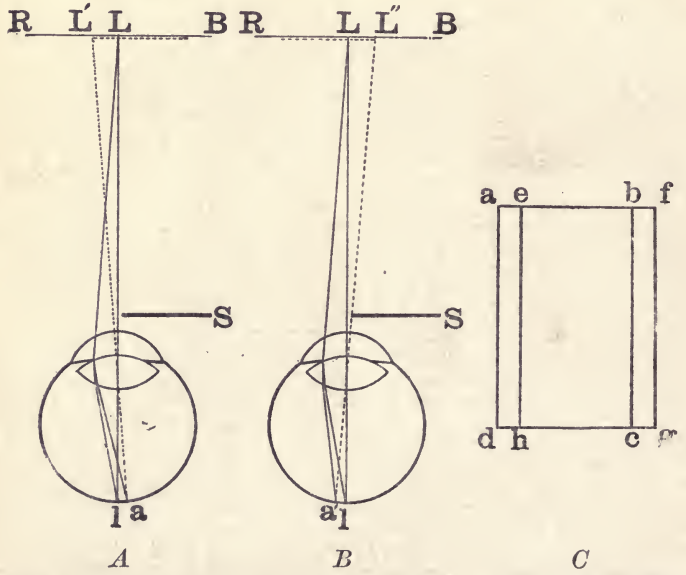
[1] This piece of apparatus originated, so far as the writer knows, with Dr. H. P. Bowditch of the Harvard Medical School.

better, put on concentric rings of the specified colors, leaving spaces between equal to the breadth of the rings. Place the diagram thus made in such a position that it shall be strongly illuminated from the right side, and view it from a distance of three or four yards with a single eye, covering half its pupil with a bit of black cardboard.

If the temporal half of the right pupil is covered, the red rings will appear to stand out slightly from their ground; the blue will appear to lie somewhat depressed in theirs. If the nasal half of the pupil is covered, the red will be depressed and the blue elevated. The same is true for the left eye if the terms nasal and temporal are interchanged. Notice in each case the apparent distribution of light and shade. Changing the direction of illumination reverses the whole phenomenon. The experiment is somewhat easier when the observer looks through a piece of blue glass (or violet or purple gelatine) held close before the eye. The edge of the card that covers the pupil may be blackened with advantage.

The purpose of the blue glass is simply to make the blue and red of the papers used in the diagram purer. In discussing the figures, it is assumed that the colors in question are perfectly pure, and that the right eye is taken for experiment, with the temporal half of the pupil covered.

The illusion depends upon the interpretation of the apparent shadows and high lights. These arise from chromatic aberration, which is made much more apparent than in the normal eye by half covering the pupil. The matter will be made clear by an examination of the figures below.



It is impossible to accommodate the eye at the same time for both red and blue; if the red rays are brought to a focus on the retina, the blue rays are focused in front of it; if the blue rays are brought to a focus on the retina, the red rays are focused behind

it. In the figures above L represents the line of demarkation between a red area and a blue area; in Fig. A the eye is accommodated for the red; in B for the blue. In A the edge of the red in the retinal image lies at l, the edge of the blue at a, which, when referred outward on the line of direction $a\,L'$, locates the blue edge at L', a shifting toward the left. The red edge is perceived at L in its true position. Similarly in Fig. B accommodation for the blue causes an apparent shifting of the location of the edge of the red to L'', a shifting toward the right. Any intermediate degree of accommodation would cause a shifting of both the red and the blue in opposite directions. In Fig. C is shown the result in the visual field of such shiftings. Assume that $a\,b\,c\,d$ represents a red strip on a blue ground. When this combination is viewed under the conditions of the experiment, there is a mutual shifting of the colors, so that the strip $a\,b\,c\,d$ appears in the position $e\,f\,g\,h$. The result is a summation of the colors in the region $b\,f\,g\,c$, and an absence of all color (darkness) in the area $a\,e\,h\,d$. The region of summation is taken as a high light, the region of darkness as a shadow—a condition of things that would be exactly paralleled if a slight elevation existed in a field illuminated obliquely from the right.[1]

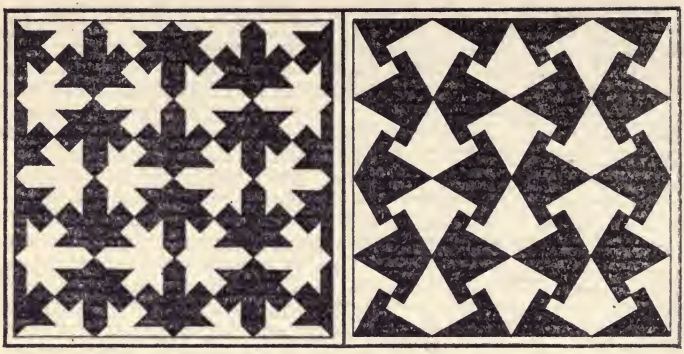
In a way entirely similar to that just used, the cases of red figures on blue ground, of vision with the nasal half of the pupil, and of vision with the left eye, can readily be explained.

a. Helmholtz, 772; F. 798 f.; Oppel.
b. Einthoven.

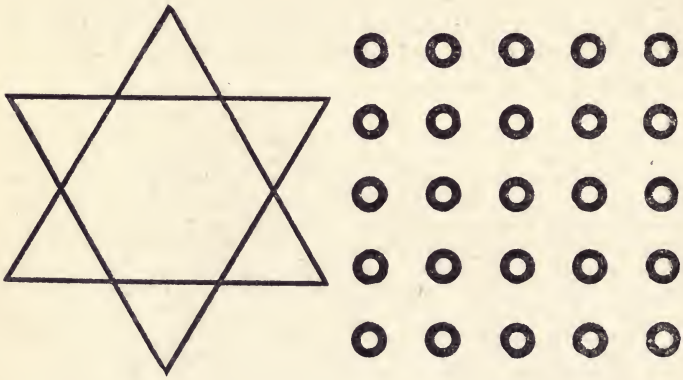
176. Equivocal Figures. The last few experiments have already made clear that much of our ordinary seeing depends on an unconscious taking into account of certain elements of the general visual sensation, *e. g.*, the size of the retinal image in connection with distance, the partial covering of some objects by others and the arrangement of shadows. The nature of the percept is thus influenced by the presence of other percepts—by the perception of distance and general direction of illumination. In certain other cases the influence of these inner factors is even clearer, because voluntary changes in them bring about striking changes in the total percept. Some examples of these cases are gathered below.

a. Plane Figures. In A and B below the black and white figures are precisely alike, except in position, and either may be taken as background for the other. With the change of background, however, a sort of change of attitude is involved which is interesting. Something similar happens in C, which may seem a star made up of interlacing lines, two superposed triangles, or a hexagon with six little adjacent triangles. In D the twenty-five dots of the square may be grouped among themselves in many ways: a single square of dots; five vertical or horizontal lines; two concentric squares and a central dot; an equal armed cross filled out with four squares of four dots each, etc. A little self-observation will probably show that the change of attitude leads at once to a change of eye movements, often merely incipient, by which the new patterns are followed out.

[1] It is only fair to state that Einthoven, from whom this experiment is taken, while using the apparent shadows as the basis of his explanation, rejects that given here, which depends on direction of illumination. The whole thing is a matter of perceptive interpretation, in which individual difference may well be expected, and several factors may coöperate. In repeating the experiments, however, the apparent direction of illumination has seemed to me the chief factor. Exceptions to its dominance have sometimes occurred, but for easily explicable reasons.



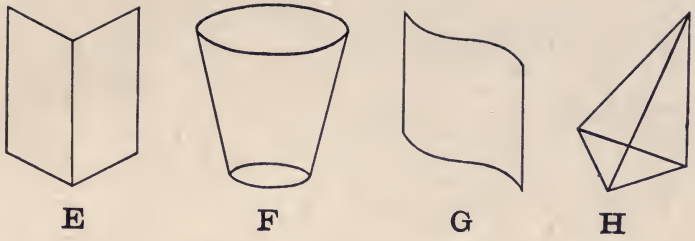
A B



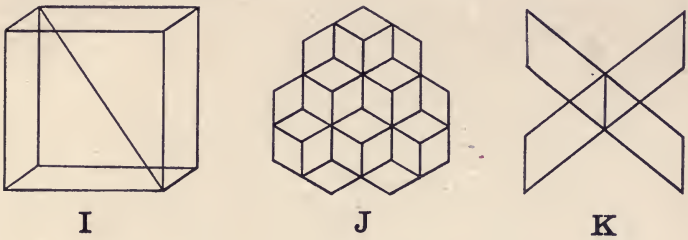
C D

b. Perspective Diagrams. In the accompanying figures it is the interpretation of the space relations of the parts of the figure that change.

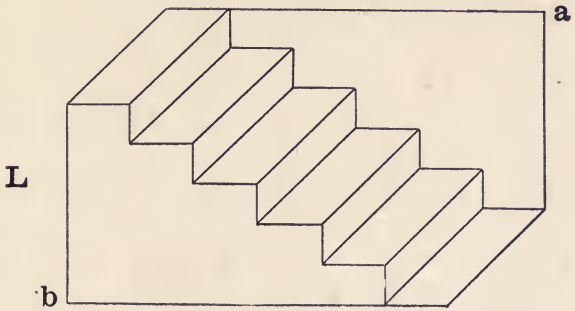
E (from Mach) represents a half-open book, and may be seen both concave and convex, the former probably being generally seen first. *F* is a glass tumbler seen from the top or from the bottom; occasionally also it may appear bent so that both top and bottom are both turned toward the observer. In *G* (from Mach) the curved lines are subject to interpretation as concave at the right and convex at the left, and *vice versa*. *H* (from Mach) is a triangular pyramid, of which the longer side is either nearest the observer or farthest from him. It also has a third interpretation, namely, as a quadrangular pyramid looked at from its apex; the diagonals of the figure then appear bent towards the paper on either side of the apex. *I* is a figure known from its originator as "Neckar's cube." Notice the change in the position of the diagonal as the cube takes one position and then the other. *J* is a set of



E F G H



I J K



M

N

perspective cubes which appear three in the lower row, two in the middle row and one on top, or two in the lower row, three in the middle row and two on top. This figure is evidently a reduplication of Neckar's cube. *K* (from Mach) represents a pair of intersecting planes, with the line of intersection perpendicular to the paper, or lying parallel to it. *L* is "Schröder's stair figure." It generally appears first as the upper side of a flight of steps; with some effort, however, it may be seen as the under side of such a flight, or the overhanging portion of a wall. It is evidently a complication of the simple figure in *E*. *M* represents part of a narrow carved frieze from Hoppe. The little figures that compose it appear depressed or elevated. With some difficulty a part may be held as depressed while the rest are elevated, but the result is unsteady, probably because we are less accustomed to mixture of figures in such decorations than a repetition of single figures. *N* is similar to *M*, but introduces light and shade. Changes in the position of the figure with reference to the source of illumination generally involve a change from convexity to concavity, or *vice versa*. All these perspective figures have of course the intermediate interpretation of plane figures, though this is sometimes hard to hold after experimenting with the tri-dimensional interpretations. Some of the changes of form are at first a little difficult for some observers, but once gotten are easier to get again. Turning the diagram upside down is sometimes helpful. Loeb reports that moving it slowly to and from the eye causes it to change back and forth, and Mach finds these changes brought about in a slightly more elaborate figure by slow vertical movements. The Schröder figure is caused to change by vividly conceiving the plane *a* as nearer than *b*.

Notice that in all the figures changes in the position and dimensions of lines and surfaces of the figures invariably accompany their change from one interpretation to the other. In *E*, for example, when the figure is convex (the middle line nearer the observer than the rest), that line inclines, if at all, toward the observer; when the figure is concave, it inclines backward and is much larger. The relative length of the sloping lines at the top and the bottom may seem to also change slightly. It is interesting to notice that of all the possible spatial figures which could correspond to these diagrams geometrically, only a very few extremely definite ones appear to perception.

c. Three-dimensional Figures. An inversion similar to that observed in *b* can be seen with real objects when conditions are favorable. A simple experiment can be made with a visiting card bent in the middle so as to enclose an angle of about 120°, which gives a figure resembling *E* above. Set the card with the fold vertical on a table, where the light will fall parallel to one side, thus obviating the cross shadows in part (Ex. 175), and look at it from a distance of a couple of yards with a single eye. The card, like *E* above, may be seen as either concave or convex. Notice in this case, as in *b*, the changes of form and position that take place when the figure is changed from convex to concave. Notice also that when the card is seen in its illusory form (convex when it is really concave, or *vice versa*), the shadowed parts seem a deeper gray and the illuminated parts a brighter white than when the whole is correctly seen. The writer finds the experiment a little easier when the card is on a rather low table and he observes standing. The card then has the top of the table as a uniform background.

Very fine effects are to be had with casts of objects in shallow relief, either in intaglio or cameo form. In these cases the nature of

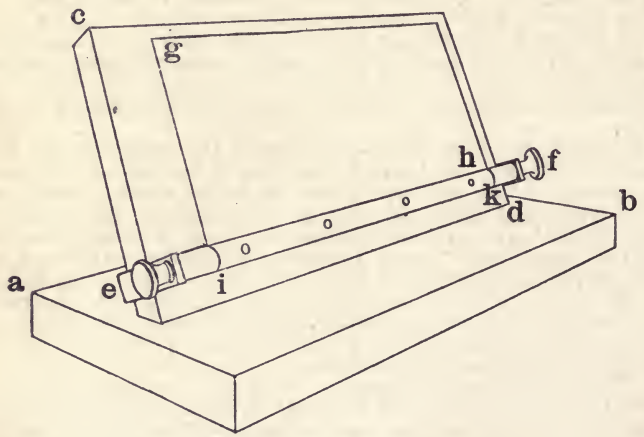
the object represented is said to be important, letters, numerals and geometrical figures turning easily either way. Natural objects, human and animal forms, and especially faces, turn easily from concave to convex, but with difficulty, if at all, from convex to concave. Compare, for example, the ease of seeing the concave mask in Ex. 175 *a* in convex form with the difficulty of getting the convex mask to appear concave.

On *a* see von Bezold, 253; Mach, *D*, 89; James, I, 442 f.
On *b* and *c*, Helmholtz, 770 f., F. 795 f. (626 f.); Wundt, *A*; 3te Aufl., II, 174, 795 ff. (626 ff.); 4te Aufl., 199 f.; Mach, *B*, 405 ff., *C*, *D*, 94 ff.; James, II, 253 ff.; Loeb; Hoppe, *A* and *B*; Brewster; Sully, 95 ff.; Beaunis, II, 569.

Apparatus.

But little special apparatus is needed for the foregoing experiments.

Krypteon. The piece, which for lack of another name I have ventured to call a krypteon, is very simple in principle—nothing more, indeed, than a slanting board with a flap hinged at the bottom. Its purpose in Ex. 170 is to furnish a means of showing the Galton bar in a way that facilitates judgment without movements of the eyes. It is roughly pictured in the cut below.



On a base board *ab*, 8x20 inches in size, is set the board *cd*, 6x18 inches, inclined backward about 30° from the vertical. At the ends of this board near the base are fastened short brass arms, which extend forward and support the rod *ef*. They are of such length as to bring the middle of the rod five-eighths of an inch from the board *cd*, and seven-eighths from *ab*. The rod *ef* is provided with milled heads at the ends, so that it may be rotated easily with either hand. The rod itself is composite, being made of pieces of half-inch half-round brass, put together, flat side to flat side, to make a single round rod. The forward half of the rod is in three pieces. The middle piece *ik* is held in place by screws and can be removed; the end pieces are soldered fast to the back half of the rod. This arrangement makes it possible to clamp securely into the rod the cardboard flap *gh*, or to interchange flaps if for any reason this

is desired. When the flap is in position, the turning of the rod *ef* will rapidly cover or uncover anything placed upon the inclined surface *cd*. In using the krypteon in Ex. 170 a narrow strip of wood should be tacked along the inclined surface to support the Galton bar. The instrument is not confined in its usefulness to this single experiment, but can be used for any in which a sudden revealing or hiding of an object is desired.

GALTON BAR. This piece can be had ready-made of the Cambridge Scientific Instrument Co., St. Tibb's Row, Cambridge, England—"Line Division Testing Apparatus"—at a price of 18s. As furnished by the Cambridge company, it consists of an ebonite strip 10 inches long, 1 inch wide and 0.125 inch thick. On the back of this and extending over a little on to the face, is a light brass slider. The parts which extend over upon the front carry between them, crosswise of the bar and close to its surface, a white thread, which divides the bar into two portions—equal or unequal, according to the position of the slider. On the back of the bar a fine line is cut, which divides the bar exactly in the middle.[1] On the back of the slider there is a rectangular opening through which this line can be seen, and in the edge of the opening a scale divided to tenths of an inch, by which the displacement of the slider from the true middle can be read at once in tenths of an inch (or by estimation in hundredths), or, since the bar is ten inches long, directly in percentage of the total length. It is evidently easy to make such a bar from any rule, divided on one side only, or even with a straight slat on which a strip of millimeter paper has been pasted.

The concave mirror used in Ex. 174 *b* is to be had of any optician or physical instrument maker at small cost. The mask for Ex. 175 can be purchased at a toy store and colored within in the laboratory. Medallions for Exs. 174 *b* and 176, in plaster and about four inches in diameter are to be had in many art stores at a very low price. Casts of these in opposite relief can easily be taken in the laboratory. The other things needed—cards, pins, colored papers, convex lens and an opera glass—have either been used in previous experiments or can be found without difficulty.

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[1] There are also two other lines on the back: one at a distance from the end equal to one-third the total length of the bar; and the other at a distance from the other end equal to one-quarter the total length. These are convenient for other tests, estimating one-third or one-quarter by eye, but are not of importance for Ex. 170.

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[1] In the references to Helmholtz the first pages given are for the second (German) edition; those following the letter F are for the French translation; those in parentheses are for the first German edition.

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I. NEUROLOGICAL.

Biologische Untersuchungen. GUSTAF RETZIUS. Neue Folge, Stockholm, 1890-94, Vols. I-VI.

This monumental work contains forty-five papers of critical interest to the student of biological science, especially in its neurological and histological departments. In fact, thirty-eight of the papers deal with special problems of the nervous system. The present series is stated to form a continuation in new form of the "*Biologische Untersuchungen*," published by Retzius in 1881 and 1882, the issue of which was interrupted among other things by his great monograph, "*Gehörorgan der Wirbelthiere.*" The large form adopted is cumbersome, but has been chosen to avoid folding of the plates. Since there are one hundred and thirty-eight of these magnificent productions, this feature may be accorded the right of deciding the form. The long lines, however, make reading difficult, and this might have been so readily obviated that there seems no excuse for inflicting this inconvenience on the reader.

The work is evidently intended as a repository for critical reference, and no attempt can be made in the limits of a review to even summarize its contents. The earlier volumes deal largely with the nervous system in the invertebrates and lower vertebrates, together with its relations and mode of nerve supply and termination in the various sensory and motor organs, the chief methods employed being the Golgi and methyl blue in their various modifications. Great prominence is given in the last two volumes to the glia elements and Cajal'schen Zellen in the human and mammalian brain, four separate papers with thirty-two plates being devoted to them. Almost infinite variety of form and type is revealed, but in their manifoldness we are unable to detect any ground for Ramon y Cajal's recent theory that the glia elements by their contractions and expansions make and break contacts of nerve cells, and thus occasion states of sleep and waking. Retzius considers the glia elements to be not only supporting structures, but padding for the nerve cells as well. Hence they are more numerous where the nerve elements are scarce, and vice versa. That they may be thus actively contractile, he admits to be possible, but for such functions there is no evidence at present ("*keine Beweise vorliegen*"). He also declares himself "*kein Freund von schwebenden Hypothesen.*" In his first volume he discussed in a most helpful manner the structure of "*Muskelfibrille und Sarcoplasma,*" and I must admit a little disappointment at finding nothing on the minute structure of the nerve fibre and particularly of the nerve cell. We may hope that the author will be spared to do this justice in the near future.

On the whole this series is indispensable to every working laboratory. The plates are luminous, and make it possible for the eye-minded to learn at a glance what they might fail to gain so well by reading pages of descriptions. C. F. H.

The Function of the Frontal Lobes. L. BIANCHI. Brain, LXXII, pp. 497-522, 5 Figs. London, 1895.

Hitzig's shrewd observation that the frontal lobe increased proportionally to the rest of the brain as we ascend the scale of intelligence from cat, dog, monkey to man, leads naturally to the inference that this is the centre for intellectual functions. His experiments on dogs, however, did not yield much support to this view. Still, from the absence of any demonstrable sensori-motor functions, the function of intelligence was almost forced upon the pre-frontal region by exclusion. The work of Ferrier, too, strengthened this position, since he found in monkeys loss of attention, apathy, etc., resulting from ablation of the pre-frontal lobes. On the other hand a definite function has been found for this region by Munk, Luciani, and recently by Groslik, in furnishing innervation to the muscles of the trunk.

Bianchi operated on twelve monkeys and six dogs, all successfully, and describes in this paper the results of excision of both pre-frontal lobes in one dog and three monkeys. Unilateral ablation produced no observable defect, either sensory or motor, lasting for more than a few days. Previous observers have gone astray, mainly from the fact that they have attached too much importance to the phenomena of irritation immediately following the operation. Bianchi states that these should be systematically disregarded for at least a week.

Passing briefly in review the chief results, we may observe that in the dog we find all motor and sensory functions normal, but his character is changed. "He goes about with eyes downcast, and head bent down, almost touching the floor with his nose." "Hovers about heavily and aimlessly." He picks up everything he finds, leaves, sticks, filth, in his mouth and drops them again. He becomes very timid and makes no attempt at defense. "Frightened, it doubles itself up without any attempt to escape from the attack."

The monkey gives similar, but even more striking results. Previous to the operation she has been taught a number of tricks, understands language without gestures, is very affectionate, as shown by her treatment of her companions, and especially her attachment to two puppies which she has adopted and mothers. She will not allow them to be taken away from her.

Considerable weakness results from ablation of the left frontal lobe (3½ g. being removed), especially marked in the right arm and right eye. She is still intelligent, takes an interest in her surroundings. She now cares for one puppy with her left arm and avoids the second. About eighty days after first operation, the right pre-frontal lobe was similarly excised. Marked and permanent results follow. Taste is so much impaired that she takes, chews and swallows bits of sugar and plaster indifferently and automatically. A normal monkey rejects with evident disgust a cherry which has been filled with quinine, while after ablation of the frontal lobes, she eats it, but with some hesitation. Vision remains considerably impaired. Psychically "the habitual state is one of indifference; and she speedily relapses (after being aroused) into an aimless automatic mode of life, without any in-

terest in her surroundings." She ceases to play with companions, and shows neither affection nor jealousy when they are petted, but is timid and frightened without cause. Automatic restlessness, with tendency to rotation toward the right, also persists.

The general picture resembles quite closely that obtained by Ferrier, and leads Bianchi to the conclusion that the chains of nerve elements from sensory or motor terminations lead up to the nerve cells of the pre-frontal region as the apex of the personality. "The frontal lobes would thus sum up into a series the products of the sensori-motor regions, as well as the emotive states which accompany all perceptions, the fusion of which constitutes what has been called the psychical tone of the individual. Removal of the frontal lobes does not so much interfere with the perceptions taken singly as it does disaggregate the personality, and incapacitate for serializing groups of representations." "Fear is an immediate result of psychical disaggregation from defective sense of personality, and unbalanced perception and judgment." Thus it becomes a characteristic phenomenon.

If so simple an observation as the transit of a star across the spider line needs correction for "personal equation," what shall we say of observations as complicated as the above, extending over days, weeks and months? At best we can place these observations beside those of Groslik, and making due allowance for personal equations of insoluable terms of complexity, they may both be true to the facts and still leave many more facts unobserved and unrecorded.

It must be remembered also that Schæfer and Horsley obtained results diametrically opposed to those of Ferrier and Bianchi. Their method consisted in making the excision of the pre-frontal lobes, leaving the excised portions *in situ* and thus escaping pressure changes in the skull. Their trick monkeys were as active and intelligent after as before the operation, and their method of operation, it would seem, has much in its favor. C. F. H.

Defective Development of the Cerebellum of a Puppy. J. S. Risien Russell. Brain, LXXII, pp. 522-30, 5 Figs. London, 1895.

An entire litter of puppies from normal parents show such marked symptoms of incoördination and instability as to point to congenital defect of the cerebellum. One of the litter comes on this account into Dr. Russell's hands, and he is enabled to add to his important contributions to cerebellar anatomy and physiology. In walking, this puppy would fall in every direction equally, and when sitting or standing there was almost constant oscillation of the head and trunk. These phenomena indicated bilateral defect of the cerebellum, a diagnosis amply borne out by the autopsy findings. The cerebellum was found to be about three-fourths the normal size, and symmetrical. Section showed a peculiar condition of the white and gray matter, the molecular layer of the cortex being in many parts much thinner than normal, giving the folia a shrunken appearance, while in a few places it was three or four times its normal thickness. The great defect, however, was found in the Purkinje cells. In large parts of the cerebellum these cells were completely absent, in others one or two were to be seen here and there, while in a few places irregular groups or clusters of these cells were to be seen, the outer margin of the cluster being at the junction of the granular and molecular layers, while the cells invaded the granular layer to a considerable extent.

Great variations in shape and size also occur among the Purkinje cells. Their extreme paucity in the hemispheres and more nearly normal relations in the vermis are also a point of importance.

All other structures at higher levels, cerebral cortex, optic thalami, red nucleus; and at lower levels, medulla, inferior olives, spinal cord, were apparently normal in every respect. The dentate nuclei were also normal.

In Russell's cat with defective cerebellum, a review of which was given in the last number of this JOURNAL, the hemisphere and dentate nucleus of one side were defective, especially the dentate neucleus, which was represented by only a few scattering cells. The inferior olivary body of the opposite side was absent as well. This difference would indicate, as Russell remarks, with almost the definiteness of an experimental extirpation, that the cells of Purkinje in the cerebellar cortex had little relation with the olivary body, while the dentate nucleus is closely associated with it. As pointing to the functions of the cerebellar cortex itself, therefore, without complications with centres at lower or higher levels, this case gives the best evidence that we have at present. C. F. H.

Studies on the Lesions Produced by the Action of Certain Poisons on the Cortical Nerve Cell.—I. Alcohol. HENRY J. BERKLEY. Brain, LXXII, 473-96, 17 Figs.

The animals used were rabbits, to which pure alcohol had been given for a considerable time, generally several months. These were compared with similar preparations from normal animals. The chief results are confirmatory of the findings of Andriezen. The blood vessels are found somewhat altered, the smallest arteries being "irregularly shrunken, at intervals almost botryoidal in appearance." This is not a constant phenomenon. The nerve cells, about one in three, are decreased in size, the nuclei appear a little irregular and shrunken, and the nucleolus especially, instead of being spherical and sharply defined, is much enlarged and very irregular in outline. By a modification of the Golgi method applicable to material already hardened in Müller's fluid, an alteration of the dendritic processes of the cortical cells in the cerebrum and cerebellum (Purkinje cells) is made out, resembling those described by Andriezen. The "contact gemmules" are lost and the processes become irregularly swollen. Berkley finds no alterations of the neuron. The affection of the dendron is the most striking alteration, and it is not claimed to be characteristic for alcohol poisoning. C. F. H.

Einige Hypothesen über den anatomischen Mechanismus der Ideenbildung, der Association und der Aufmerksamkeit. S. RAMON Y CAJAL. Archiv für Anatomie und Entwickelungsgeschichte, herausgegeben von His. 1895, 4th-6th Heft.

The Spaniard of Barcelona, of such world-wide reputation, has with perfect right ventured over the line of strict anatomy into the provinces of psychology. The invasion is a welcome one. Such scientific incursions are like that of the spies into Canaan—they bring back rich and exceedingly good fruit. The first part of the discussion deals with the question, "*Has the individual perception one or several nerve cells for underlying basis?*" The recent investigations into the structure of the nervous system all demonstrate that many, very many, cells and fibres are engaged in the slightest sensation. From the sense organ to the cortex there is a well

connected chain of conductors or neurons which transmits avalanche-like (*lawinenartig*) any single sense impressions on the periphery to an ever growing number of cells and fibres until it finally reaches the cortex. Thus in the fovea centralis retinæ, in which the vision is clearest, one rod affected by light stimulus transmits the excitation to a bi-polar cell; this conducts it further to a ganglion cell beneath it (cell of the ganglion layer), the nerve process *(Fortsatz)* of which, branching out richly in the fore corpora quadrigemina, spreads the movement over a considerable number of cells, and finally the axis cylinders of these cell groups end in the occipital part of the cortex, where they come into contact by means of their branches (*Verzweigungen*), with the end brush-like formations of a large number of pyramidal cells. Thus the original peripheral unit of excitation has been able to impart its excitation to hundreds or perhaps thousands of nerve cells in the cortical centres of vision. (Spencer's analogy *re* mode of increased momentum of nerve movement—a row of bricks falling—might be suggestive here also.) So with the other senses.

The second part deals with *hypotheses concerning the histological mechanism of association of ideas, of sleep, and of the waking condition.* Duval's "*geniale*" histological hypothesis concerning the nature of sleep and rest, viz., the condition of *contact* between the nerve cells and their processes, is rejected. So also is Rabl-Rückhard's well-known hypothesis of the amœba-like prolongations and retractions of the nerve fibres and end brushes in thought and sleep respectively. The chief causal mechanism in association, etc., Ramon y Cajal attributes to the neuroglia cells. Here we have the pseudopodian movements of contraction and relaxation. During their state of relaxation their pseudopodia extend and intervene between the cells and their protoplasmic processes and the nerve branches (*Verzweigungen*), in consequence of which the passage of the nerve currents is either completely stopped or considerably hindered. Thus we may gain an explanation of the nature of mental rest and of sleep, both natural and artificial (narcotics, hypnotism). The third part is on the *theory of attention.* One of the three kinds of neuroglia cells are the *perivascular* cells. These are found only in the neighborhood of the capillaries of the gray substance. Each capillary has inserted in it thousands of these neuroglia pseudopodia, which diverge in all directions. Upon contraction of these there follows a local enlargement of the vessels, and thereby greater physiological congestion. This congestion of the capillary vessels increases their size, filling out almost the whole of the surrounding lymph space. Hence the *monoïdeism* of attention. At the close of the article, which is full of suggestions and details, the author calls attention to the hypothetical nature of some of his conclusions.

ARTHUR ALLIN.

II. EXPERIMENTAL.

Die Aufmerksamkeit und die Function der Sinnesorgane. Von DR. W. HEINRICH. Erster Beitrag. Zeitschrift für Psychologie und Physiologie der Sinnesorgane, IX, Heft 5 u. 6.

The latter part of this article is experimental in nature. Helmholtz ("Physiol. Optik," 1867, S. 741) makes the assertion that attention is independent of the accommodation of the eye, basing his assertion upon the facts of indirect vision. While steadily fixating

an object centrally, the attention may be turned to an object on the side, with the result that while there is no change in the accommodation of the eye, there is in the attention, and in the objects perceived. So Helmholtz, and also Pilzecker in his train.

Heinrich points out that Helmholtz's statements are only the results of subjective perception; there is need of an objective investigation, as "self-analysis" may not reveal the state or change of the eye during the experiment. He therefore observes the pupils and lens with the help of an ophthalmometer. He determined carefully the size of the pupil (1) in central fixation, (2) in indirect vision, and (3) in reckoning. From the various tables it is evident that when the subject turns his attention to the object seen on the side, the pupil *enlarges.* For example, Table III gives the size of pupil centrally fixated at 3.0091 mm.; with object seen at angle of 50° as 4.9094 mm.; and at 70° as 3.9514 mm.; and during mathematical calculation at 6.0565 mm. The size of the pupil varies continually. If the attention be claimed by *non*-optical impressions, the pupil loses its condition of accommodation. Helmholtz is wrong therefore; the attention, at least in this case, is accompanied by the accommodation of the eye.

Dr. Haab *(Neurologisches Centralblatt, 1886, 1 Mai,* and in *Correspondenzblatt f. Schweizer Aerzte, 1886, 15 März)* reports a case of pupil-reflex not noticed by Heinrich. Again it is a case of indirect vision and attention; but here it is not an enlargement, but a *contraction* of the pupil! He regards it as probably of cortical origin and cites psychiatrical cases to illustrate his argument. The discrepancy between the statements of Haab and Heinrich is probably due to the objects fixated (lamp, dark wall, etc.) and the respective positions occupied by the subjects examined. The different results, however, demand more experimentation. In either case, however, Helmholtz's view is amply refuted.

ARTHUR ALLIN.

Das Verhältnis von Accommodation und Konvergenz zur Tiefenlokalisation. Von Dr. FRANZ HILLEBRAND. Zeitschrift für Psychologie, VII, 1894, 97-151.

On the Relation of Accommodation and Convergence to Our Sense of Depth. By E. T. DIXON, Mind, N. S. IV, 1895, 195-212.

In the experimental study of the relation of accommodation to space perception, Hillebrand's sole predecessor is Wundt, who published on the subject more than thirty years ago. Wundt's general concusion was that, all other means of perception being excluded, differences of distance could be perceived by differences in an "accommodation feeling;" Hillebrand's is that such a feeling does not exist. This conclusion rests on two series of experiments. In one a fixation line was moved slowly to or from the eye of the observer, and he was required to say whether it was approaching or receding; in the other, the observer's eye being accommodated for a fixation line at rest in the field, the line was suddenly removed and another at the same or a different distance substituted for it. For the detail of the apparatus and for the many necessary precautions to be observed, the original should be consulted. Suffice it to say here that with possibly one small exception to be noticed below, the conditions leave nothing to be desired. The first series of experiments showed an almost uniform inability on the part of the observers to judge—much less to "sense"—the direction in which the line was traveling. In the second series it

G. E. Müller's excellent little work on Attention is criticised, also his disciple's Pilzecker. The defects of both might have been more fully emphasized.

Wundt's observations on attention are said to be faulty and defective, and his views to be too much influenced by his philosophical conceptions. Wundt's definition of attention: an activity which is perceived along with the going and coming of presentations, and which is accompanied subjectively by a feeling which cannot be more nearly defined,—is strongly criticised.

N. Lange, Külpe, Ziehen and Münsterberg receive sympathetic handling. He makes Münsterberg a disciple of Ribot, inasmuch as attention is regarded by both as a complex of muscle-sensations, and the fluctuation of attention as dependent upon the fluctuation in the strength of muscular contractions.

The author's standpoint is that of Avenarius. His exposition is generally fair; his criticism might often have been severer. He strangely omits all mention of the work of Profs. Ebbinghaus, Hering, Lipps and Stumpf, the latter's well-known theory of attention being not once mentioned.

ARTHUR ALLIN.

Die Gefühle und ihr Verhältnis zu den Empfindungen. Antrittsvorlesung. Von DR. MAX VON FREY, 1894.

Of the many recent researches into the nature of pain and pleasure and their physiological causes or concomitants (Marshall, Nagel, Nichols, Strong, Oppenheimer, Goldscheider and others), Dr. Frey has contributed his share. His contributions to the physiology of the pain-sense have already been ably reviewed in this JOURNAL (Vol. VII, pp. 113 ff.) by Mr. Luckey. We have here a compact survey of the more general field of feelings in their relation to what are ordinarily called sensations. The characteristic of feeling, whenever it is associated or accompanied by sensation, is held to be the reference to the personality of the person experiencing the sensation. What "personality" may mean here, whether parts of our organism or the mental self, is not explained. He maintains his former thesis that pure sensations, *e. g.*, touch, may be had without any accompaniment of pleasure or pain, and that pain has its own separate nerve endings and pain-conducting nerves. Such are denied the feelings of pleasure, which are somehow connected with the cessation of pain, tension, etc. The "shunt-theory" of Wundt and the older school is not accepted, the objections to it being too conclusive. The pain sense is the only one possessing organs almost everywhere in the body. This great amount of distribution, its usual lack of reference to the objects of stimulation, and its full reference to the organism stimulated, form the first and most pressing step in the formation of a presentation complex, known as the ego. The connection of this with that primordial characteristic, irritability, might have been pointed out.

He disallows the James-Lange theory, but approves of that of Meynert, which to me is largely the same, though not developed enough. By the way, Meynert published his theory of the emotions in 1880, "*Ueber die Gefühle*," now published in his "*Sammlung;*" the James-Lange theory appeared in 1884. Frey's arguments against separate nerve endings for pleasure are not conclusive. His distinction, the general one, between feeling and sensations, has probably worked more harm than good. Frey's answer to the strictures of Nagel (*Pflüger's Archiv*, LIX, 1895) upon

his hypothesis of separate nerve endings, will be interesting. The plain distinction between disagreeableness and pain is, as usual, also not noted.

ARTHUR ALLIN.

Suggestion und Reflex. Eine kritisch-experimentelle Studie über die Reflexphänomene des Hypnotismus. K. SCHAEFER. Jena, Gustav Fischer, 1895, pp. 113.

We have here a flag of truce appearing in the combat between the opposing forces of the school of Nancy and that of the Salpêtrière. The mediator is a third person, who proclaims that both are right, and that suggestion on the psychical side as well as the reflex phenomena on the somatic side are only two aspects of one single process, or perhaps better still, are two parallel processes associated. Association of ideas, and the movements accompanying usually the ideas, are the parallel processes. "Suggestion is nothing else but an immediate association" (p. 112). Bernheim's words are approved: "The mechanism of suggestion can be thus generally formulated: *Increase of the ideo-motor, ideo-sensitive and ideo-sensorial reflex excitability.*" As strychnine increases the sensitive-motor excitability in the spinal cord, so that the lightest stimulus on a nerve ending transforms itself immediately into contraction, without the possibility of any inhibitory influence of the brain, so hypnotism is the increase of the ideo-reflex excitability of the brain, each presentation as it appears is immediately followed by its associated movement (p. 112). "Suggestion is then to be considered as a psychical, anatomically considered, cortical reflex" (p. 113).

Since suggestibility is a cardinal symptom of hysteria, it is not to be wondered at that senso- and neuro-muscular hyperexcitability is called an "hysterical" phenomenon. The highly pronounced suggestibility is conditioned by a very considerable sinking or diminution of central inhibition. The hypnotic reflex phenomena are not always "hysterical;" association and absence of central inhibition, wherever they occur, are the chief and distinctive features. Hence the hard and fast distinction between the phenomena of *suggestion* and *reflex* falls away.

The experiments are well performed, and the whole work is essentially a worthy contribution to the subject. Suggestion has even a wider application than in the abnormal field. A robber, for example, is seen on the lonely highway at night; upon closer examination it is seen to be the stump of a tree. We have here the phenomena and actions of suggestion. So with all sense-illusions. Even conversation is a continual suggestion, illustrating continually the action of the association of ideas and cortical reflexes. Suggestion is *not* a *disturbance* of association as Parish *(Trugwahrnehmung)* and many others assert. It is a continual illustration of most excellent association. Only by these means do we have the resulting phenomena. "The disturbed association" is in the external world, in the environment. The cortical mechanism works as it has been taught to work; it is not its fault if the environment changes.

ARTHUR ALLIN.

BOOK NOTES.[1]

(G. S. H.)

The Structure and Life of Birds. By F. W. HEADLEY, M. A., F. Z. S., London. Macmillan & Co., 1895, pp. 412.

This book, by the assistant master of Haileybury College, has seventy-eight illustrations, and attempts to prove the development of birds from reptilian ancestors and to explain "the main principles of their noble accomplishment—flight, the visible proof of their high vitality." Their color, song, instinct, reason and migration are considered. Song, it is said, is instinctive, but must be awakened by learning. One bird may learn the song of another species, but his own is never lost. Intelligence helps and modifies the nest-building instinct. Instinct is more than habit petrified and transmitted. Migrations, which may be 7,000 and even 10,000 miles, are most fully described.

Studies in the Evolution of Animals. By E. BONAVIA, M. D. Westminster, 1895, pp. 362.

The author's chief contention is that spots and stripes on horses, zebras and tigers are due to old carapaces of their armadillo-like predecessors in the vertebrate series. Mottled and dappled figures are skin rosettes, persisting after bone-like rosettes are gone. Tails preserve their rings longest. Of course colors are not preserved in rocks, hence the problem is an open one. Some of the illustrations are striking. Corns and horse warts are modified skin glands, which are survivals from a pachydermous past.

L'industrie des Araneina. W. WAGNER. Memories de l'Acad. Imp. des Sciences St. Petersburg. 1894, pp. 270.

This comprehensive study of the architectural instinct of spiders (ten plates) is the most exhaustive yet made. Its main conclusions are that the texture and form of the cocoon conform in general with the biologic classification; that the many varieties arise not by inheritence of fixed intelligent acts, but by blastogenic or innate modifications and that intelligence is infinitesimal; that experience aids but little, the young building nearly as well as the old. Most modifications in form and structure are conditioned by choice of place; the perfection of the nest is not the measure of material care, for some spiders care for neither eggs nor young, some species for eggs only, and some nourish the young brood, and the more perfect the nest the more the young ones are left to their fate.

Domesticated Animals. Their Relation to Man and to his Advancement in Civilization. By NATHANIEL SOUTHGATE SHALER. New York, Chas. Scribner's Sons, 1895, pp. 267.

This volume, with its 186 cuts, which have no special relation to the text, consists mostly of essays reprinted from *Scribner's*

[1] Notice in this section does not preclude fuller notice later.

Magazine, and is "intended for those persons who, while they may not care to approach the matter in the manner of the professional inquirer, are glad to have the results which naturalists have attained, so far as they may serve to extend knowledge of things that lie in the field of familiar experiences." The topics are the dog, horse, flocks and herds, domesticated birds and useful insects, with two chapters on the rights of animals and domestication. Although pleading for sympathy and protection, vivisection is defended. The book is interesting, popular rather than scientific; does not aim at presenting results of special psychological studies, but is full of well-ripened common sense, and is magnificently printed.

Beiträge zur Psychologie und Philosophie. Herausgegeben von DR. GÖTZ MARTIUS, A. O. Prof. der Philos. an der Universität Bonn. Erster Band, I Heft. Leipzig, 1896, pp. 159.

After an introduction defining the field of psychology come four papers: I. The law of the brightness value of negative after-images, 78 pages. II. A new method of determining the brightness of colors, 25 pages. III. Brightness of complementary mixtures. IV. On the idea of specific brightness of color sensations.

Ueber die Einwirkung seelischer Erregungen des Menschen auf sein Kopfhaar. DR. I. POHL. Halle, 1894, 78 quarto pages and one table.

The author has shaved very small spots on his and others' heads and measured rates of the growth of hairs. From the age of 20 to 24 his hair grew fifteen mm. per month, and at 60 it grew eleven mm. per month. For the first month after being cut, growth was less than the second, although individual hairs which stood side by side grew at different rates. Prolonged fear or anxiety causes many individual hairs to grow smaller for a short distance and when equinimity is restored they enlarge as before. The diminished length shows longitudinal striation under the microscope and also diminution of the oblong vacuoles usually found in considerable numbers in the substance of the hair. With this change goes often a slight change in color. Protracted anger and indignation have caused a decided bulge in the size of hairs during the emotional disturbance. Anæmic and plethoric states of the blood due to emotional disturbances are of course at once suggested. The work of Dr. Pohl is extremely painstaking and detailed.

La Musique et la Psycho-physiologie. Par MARIE JAËLL. Paris, Alcan, 1896, pp. 171.

In this volume music is regarded as a means of refining and perfecting our organic activity. To unify motor functions and musical sentiment by piano study, gives a solid basis to the highest aspirations of the artist. The chief topics treated are the mechanism of musical expression, attention and muscle sense, touch and audition, time and measure, interpretation, musical memory, the sensations of the hearers of music.

Philosophie et Musique. Œuvre posthume. Par LOUIS LACOMBE. Paris, Lib. Fischbacher, 1895, pp. 458.

The author's motto is, no one has genius without repose, and none have repose without wisdom. He certainly accomplished much, both as a composer and as a critic. The latter part of the book deals with very general topics, like the development of speech, music and

popular songs, pure versus worded music, etc. The studies of Bach, Wagner, Rossini, Beethoven and religious music, show more psychological insight than do J. E. Shedlock's recent expositions of the "Pianoforte Sonata."

Allgemeine Physiologie. Ein Grundriss der Lehre vom Leben. Von MAX VERWORN, Dr. Med. und Phil., A. O. Prof. der Physiologie. Jena, 1895, pp. 584.

This heavy volume, with its 268 cuts, marks or attempts to mark an epoch. On the assumption that the cell is the substratum of all the elementary phenomena of life, the author seeks to show that general physiology can be only cellular physiology. It is fittingly dedicated to Johannes Müller, whose standpoint, that physiology should be comparative, modern physiology has too much ignored. The wonted ways and means of this science have grown too narrow to insure it against false and partial generalizations and to keep wide open the way of further development. This infusion of biological material into physiology required a grouping of material from a vast field such as was never attempted before. This thought Prof. F. S. Lee of New York had before expressed, as is gracefully admitted in the preface. The author strives to write in language so little technical that doctors, philosophers, botanists or zoölogists can easily read it. In so vast and new an effort, no doubt errors and defects will be apparent. Both the effort and the interest in fundamental psychological problems shown in the author's earlier works and his suggestive views commend the work to psychologists of the scientific type.

Methods of Mind-training, Concentrated Attention and Memory. By CATHERINE AIKEN. New York, 1896, pp. 110.

Miss Aiken has been for years head of an excellent private school for young ladies at Stamford, Conn., where she has trained her classes to take in amazing numbers of written figures at a single glance, and also to memorize at a single reading stanzas of poetry, items from newspapers, etc. The object of the exercise, which is not allowed to occupy more than twenty minutes on the opening of the school day, is to quicken the perceptive faculty and cultivate the habit of accuracy in seeing and hearing. The power of voluntary attention is increased, and the success of this work was such as to change the author's method of thirty years' standing. The exercises were tried, *e. g.*, by writing music to be reproduced, on the revolving blackboard, and making it rest after it had made one revolution; the music teacher wrote that the quality of work in music was immeasurably ahead of anything ever had. Quick perception is the basis of first-sight reading and playing. Twenty dots were numbered correctly, instantly, without counting. Twenty and even thirty lines of poetry are repeated after hearing them read once. Vocabularies of some length and forms for drawing are thus learned.

Energetik und Hygiene des Nerven-Systems in der Schule. Von DR. H. GRIESBACH. München, 1895, pp. 97, with seventy-four tables and many cuts.

Brain fatigue reduces the sensibility of the skin for distinguishing compass points. The tests were made before and after school, and between lessons, Sundays, and after examinations. The results are remarkably uniform as well as very marked. A girl of 14, *e. g.*, who distinguished compass points 5 mm. apart on the glabella at 7

A. M., at noon after an examination distinguished at 12.5 mm., while on Sunday her discriminative sensibility increased to 3.5 mm. Similar results were obtained for index-finger, thumb and neck, and also with different gymnasial classes. This valuable memoir closes with a strong plea against over-work in school, based on his new method of measuring fatigue.

The Child and Childhood in Folk-thought. The Child in Primitive Culture. By ALEXANDER FRANCIS CHAMBERLAIN, M. A., PH. D., Lecturer on Anthropology in Clark University. New York, Macmillan & Co., 1896, pp. 464.

The thirty-three chapters which constitute this volume deal with the customs and beliefs of primitive people and savages concerning children's souls or training children, their food, their language, their supposed divinatory or magic powers, relations to plants, animals, celestial phenomena, etc. The book may have been suggested by Ploss, but goes far beyond that writer in many respects and covers different fields. The author is an anthropologist, whose dominant interest and training are the philology, rites, customs and beliefs of primitive people. His diligence in gathering this vast body of material is remarkable. The book is the first and only one of the kind in English, and is sure to fascinate parents of young children as well as to instruct all teachers and psychologists. It marks a distinct advance in child study.

The Number Concept: Its Origin and Development. By LEVI LEONARD CONANT, PH. D. New York, Macmillan & Co., 1895, pp. 218.

This book, written while the author was a student at Clark University, treats counting, number system limits, origin of number words, miscellaneous number bases, and the quinary and vigesimal system. The anthropology of the number systems and words of all accessible records of savage races are here brought together with great labor, and presented in a well digested and lucid form, and will interest mathematicians and teachers as well as anthropologists, psychologists and philologists.

Criminal Sociology. By ENRICO FERRI. New York, D. Appleton & Co., 1896, pp. 284.

The standpoint is that of criminal jurisprudence, and the chapters are the data of criminal anthropology, of statistics and of practical reforms. The book outlines a positive system of social, preventive and repressive defense against crimes and criminals, in accordance with the inferences from a scientific study of crime as a natural and social phenomenon. The author pleads for a defensive versus the penitentiary systems of the classical school. The latter are crude, pedantic, and are becoming daily more disastrous.

Psychiatrie, für Arzte und Studirende Bearbeitet. Von Dr. Med. TH. ZIEHEN, A. O. Professor, Jena. Berlin, 1894, pp. 470.

Psychiatrie, ein Kurzes Lehrbuch für Studirende und Aerzte. Von DR. KRAEPELIN, Professor at Heidelberg. Vierte vollständig umgearbeitete Auflage. Leipzig, 1893, pp. 702.

Kompendium der Psychiatrie. Von Dr. Med. OTTO DORNBLÜTH. Leipzig, 1894, pp. 270.

Ziehen here attempts to apply the principles of physiological psychology as laid down in his little text-book to clinical psychiatry. Dropping all metaphysical hypotheses of apperception,

will, self-consciousness, etc., he finds sufficient explanatory power in the laws of association. The psychic side of brain and mind disease is given large space, and, neglecting the sixty systems of classification now offered, he suggests one based on the clinical lapse of psychoses. His groups are few and the importance of pathological physiognomy is insisted on.

Kraepelin bemoans the long retarding influence upon psychiatry that dualistic theories of an immaterial and separable soul have had. Now, while we know absolutely nothing of the relation of mind and body, our task is to work from both sides, but always empirically, to make the relation between the pathology of brain and soul less obscure. About half the book is general, treating of causes, inner and outer; symptoms, course, diagnoses and therapeutics, and the other half treats of special diseases. Like Ziehen, Kraepelin is an ardent clinician, and lays stress on the psychic side.

Dornblüth is a model of condensation, and different as his standpoint and method, he suggests Savage both in lucidity and in utilizing the experience of his own asylum.

The State Hospitals Bulletin, a quarterly report of clinical and pathological work in the state hospitals for the insane, the first number of which appeared in January, pp. 144, is published by the authority of the New York State Commission in Lunacy, and edited through a committee by all the state superintendents. With 19,369 patients cared for by 2,721 attendants and 91 physicians, such a publication should succeed, even if it does no more than to gather the medical and scientific addenda hitherto printed in the hospital reports, which sometimes are worthy of reaching a wider circle of readers. The articles in the first number are numerous, but brief as they are, their quality is good.

Heredity and Christian Problems. By AMORY H. BRADFORD. New York, Macmillan & Co., 1895, pp. 281.

Theology is now inductive, and sociology has taken a place beside it. Original sin and will are now questions of heredity. Old teachers studied books, now they study the pupil. Once the world asked, what do teachers know of books and branches? now it asks, what do they know about children? It is the "chief credential of the new education that it studies the child before it gives the child anything to study." Theology now calls a "return to Christ." He is unique, and not to be accounted for by either heredity or environment, but is absolutely unique. Now no man need despair because of his ancestry. The law and hope of the future lie in the "out populating power of a Christian stock." The author is well read in sociological problems and in modern psychology. It is refreshing to find a clergyman orthodox enough in the true sense of that noble word to read Wundt, Ribot, Maudsley, Weismann, etc., and to bring them to bear as reinforcing the basal truths of religion.

Natural Religion. By SIR I. R. SEELEY, K. C. M. G., Litt. D. London, 1895, pp. 305.

The Regius professor in modern history at Cambridge here seeks to find what ground is common to science and religion. Even negative conclusions really revive and purify Christianity. The nature of religion is misconceived. Supernaturalism, which is only an accident of it, is mistaken for its essence. Thus negations can not destroy much of religion, but only traditions transmitted from unscientific times and artificially protected against revision. Part

of this book was printed in 1882, but the last third, and best part, to our thinking, is entirely new.

Die Schöpfung des Menschen und seiner Ideale. Ein Versuch zur Versöhnung zwischen Religion und Wissenschaft. Von DR. WILHELM HAACKE. Jena, 1895, pp. 487.

As we go up the scale of animal life, we find increasing unification of the body, and this means increasing perfection of personality. Material and spiritual are two steeds harnessed to the same whiffletree, which must be kept in increasingly perfect equilibrium. Perfection from inner necessity is the law of all things, and this is creation. Growing "perfection is the categorical imperative which the world of bodies as well as that of spirit must obey." This thought makes both art and religion scientific, and puts a soul and an ideal into Darwinism. The book is intended for "naturalists, philosophers and theologians," and demonstrates that there is room for faith in the mechanical world of science. We are repeatedly exhorted to read the book through before criticising it, or before making up our minds about it. This we hereby promise to do.

From Matter to Mind. By MARCUS K. P. DORMAN, M. A., M. B. London, K. Paul, Trench, Trübner & Co., 1895, pp. 319.

The author attempts to outline some of the main principles of science, especially physiology, psychology and general philosophy. Beginning with the solar system, space, heat, matter and energy, he passes to life, vegetable and animal, up to the evolutionary stages, with chapters on sex, pain, heredity, culture, abnormal minds, will, ethics, marriage, soul, heaven, hell, theosophy, evolution and the Bible, and faith. Many summaries and practical rules are interspersed, intellectual growth is diagrammed. It is hard to imagine a class of readers in this country likely to be benefited by such a work. From no part of his field does the author seem to write as an expert.

Der Kampf um einen Geistigen Lebensinhalt. Neue Grundlegung einer Weltanschauung. Von RUDOLF EUCKEN. Leipzig, 1896, pp. 400.

Our culture lacks leading and unifying ideals, so that modern man is in danger of losing a mental content out of life. The intellectual movements of our day are a struggle for this content. This philosophy must supply by making clear man's inner relation to reality, the process of life plainer, and the room for experience larger. The author's problems are independence, character, the cosmic power of the psychic life, and their practical bearings. The distracted and contradictory consciousness of our time can save itself from despair by unfolding a more original mentality, grasping a more essential reality, and by a general advance of consciousness in all the complex world of man. The author's call to advance the kingdom of man is both impressive and inspiring. His standpoint is unique and quite different from that of the standard idealism and epistemology of our day.

Le Réalisme Métaphysique. Par EMILE THOURESEZ. Paris, Alcan, 1895, pp. 283.

This is a doctor dissertation on the value of the laws of reason. Part first treats of *abstract thought*, realism, judgment, induction, belief and skepticism. Second, *sensibility*, number, time and space.

Third, the *understanding*, categories, cause, duty, end, æsthetics. Fourth, *God*, an indefinite growth of the sense of God. Unfolding the spontaneities of the soul is the only way out of contradiction, and suggests the way of present human development.

Du Fondement de l'Induction suivi de Psychologie et Métaphysique. Par J. LACHELIER. Paris, Alcan, 1896, pp. 173.

The author, an inspector general of public instruction, here reprints his thesis, which was written in 1871, and an article from the *Revue Philosophique*, Mai, 1885, both of which were out of print. The first urges that by subordinating mechanism to finality, we are prepared to subordinate finality itself to a superior principle, and to transcend by a moral act of faith both the forms of thought and of nature. The last is a plea for metaphysics as the real science of thought.

Logic and Other Nonsense. By J. D. MCCROSSAN. London. T. Fisher Unwin, 1895, pp. 185.

Without preface or index, Amicus, Sapiens, Juvenus, Festinus converse in a delightful but leisurely way concerning life, death, free-will, sex, philosophy, science, reality, religion, etc., in a loitering, mid-summer mood, and conclude that "there is but one philosophy, and its name is fortitude."

Neoplatonism. By C. BIGG, D. D. London, 1895. Society for Promoting Christian Knowledge, pp. 355.

A concise little hand-book on this period of philosophic thought has been often desiderated. This is clear and compendious, and more than half the volume is given to Plotinus. We can but wish the seventy pages given to an outline of previous Greek philosophy had been omitted to make room for Proclus and for the later Alexandrians. Would, too, that the author had been a trifle less elementary and simple.

Essai sur le Libre Arbitre, sa Théorie et son Histoire. Par GEO. L. FONSEGRIVE. 2nd ed. Paris, F. Alcan, 1896, pp. 596.

This work, crowned by the Academy of Moral and Political Sciences, and dedicated to M. Liard, is divided into two nearly equal parts. The first treats the history of the doctrine of free-will from Socrates down to living writers, and the second part is directed to criticisms of preceding and exposition of the author's own views. 1. Luther, Calvin, Leibnitz, Spencer, Haeckel say nothing is free. 2. Scotus Erigena, Secretan and Renouvier say all is free. 3. Hume and Stuart Mill assert both freedom and necessity. 4. Bossuet and Dubois-Reymond say something is free and at the same time something is necessary, but leave them unreconciled and without mediation. 5. Aristotle and Ravaisson say both exist without contradiction, for necessity is a rapport between beings the first cause of whose existence is freedom. The author sums his own view up in a figure. Science, which deals with necessity, is a skeleton; free-will, which is a moral necessity, is flesh, heart, love. The heart thus does the work of pure reason and vindicates and rests the tranquil affirmation in a world of pure reason.

Le Psittacisme et la Pensée symbolique. Psychologie du Nominalisme. Par L. DUGAS. F. Alcan, 1896, pp. 202.

There are things it is better not to think than to think. Consciousness is a ruinous luxury. To reflect on sensations makes them

exaggerated if not morbid. Analyzed chastity becomes unchastity. Too much attention to movements makes them painful or morbid. Notation is not notion. Language may be regarded as a power of arrest or suspension of images. We may insist on the word to evoke the idea, or substitute the word for the idea which it may suppress. The latter is psittacism or parrotism, Leibnitz's term for words empty of sense. Symbolic thought, on the other hand, is latent under words, but may any time spring out. In form language may be spontaneous or scientific. The former is directly suggested by things and involves least reflections. Mental sloth engenders psittacism, while *reflection* makes thought and makes language scientific. But this is for the sake of getting yet simple and brief terms. Thus all progress follows lines of least resistance. Thus words *per se* are *flatus vocis*, *galimantiæ*, logomachies, and have no intelligence, but only the power to produce intelligence. All knowledge is symbolic and starts by the transformation of sensations into images. Thanks to association, forgetfulness is only the suspension, but not the loss of memory.

Grundriss der Psychologie. Von WILHELM WUNDT. Leipzig, 1896, pp. 392.

This volume, we are told in the preface, is primarily intended as a students' guide to the author's lectures, and secondarily for a wider circle of readers who seek general results and applications. After an introduction on tendencies and methods, the psychological field is treated in four comprehensive sections: I, the psychic *elements*; II, the psychic *forms* (concepts, space, time, feeling, desire, will); III, their *composition*, consciousness, attention, association, memory; IV, *development*, children, myth, custom; V, *causality and its laws*, the idea of soul. This outline does not deal with experiments or methods, has no tables or cuts, but sums up in a systematic way his general conclusions in the field of his life work in a ripe and we cannot help feeling in a for him final way. This work opens at last the pleasing prospect of having ere long this most masterful of modern psychologists in English.

Elements de Psychologie Humaine. Cours professé à l'Université de Gand. Par J. I. VAN BIERVLIET. Gand, Paris, 1895, pp. 317.

After an introduction on cells and tissues, the first part treats of the different sensations and movements, with general considerations on each. This "physiology of conscious phenomena" is followed by part second, which is devoted to their psychology, beginning with ideation, judgment, reason and self, and general discussions, and passing to volition and freedom, perfectability, etc. The third part is devoted to the psycho-physiology of consciousness, including images, memory, expression and character, with a closing section on psycho-physic measurements. As a whole, the method of exposition, the thirty-four cuts, the subjects chosen and the applications make this book one of the very best elementary college text-books.

Philosophy of Theism. Being the Gifford Lectures delivered before the University of Edinburgh, 1894-95, first series. By ALEX. CAMPBELL FRASER, LL. D. New York, 1895, pp. 303.

The final problems are ego, matter and God. The leading chapters consider universal materialism, panegoism, pantheism, pantheistic necessity and unity, Spinoza, universal nescience, David Hume, God in nature, man supernatural, what is God?

God is the apex and culmination of true philosophy. The theological interpretation of the universe is the final one. Nature is "God acting, so that each discovery in natural science is also a contribution to natural theology." Collision between science and religion is no longer possible. This course of lectures is introductory to a fuller one reserved for the present winter.

The Conception of God. Address by JOSIAH ROYCE, Ph. D., together with comments thereon by S. E. MESES, Ph. D., head of the School of Philosophy in the University of Texas; JOSEPH LECONT, M. D., LL. D., Professor of Geology and Natural History in the University of California, and G. H. Howison, M. D., LL. D., Mills Professor of Philosophy in the same university. 1895, pp. 89.

When we recall that since the volumes on theism by Professors Harris, Fisher, Bowne and Mr. Fiske and Howison there has been such a flood of treatises, long and short, upon the subject from such a variety of standpoints, it appears very clear that after a long period of neglect God is again becoming popular with philosophers. Not since the days when theologians did the thinking for the world in matters of the soul has deity ever had the honor of having such an anthology of proofs of His existence conferred upon Him as now, and as if in prompt response, He has revealed to several of the chosen, simultaneously, new ways out of agnosticism. To our neo-agnostic epistemological theologians, God is not unknowable, He is not even unknown; nay, He is knowledge itself even of the external world. Man, and especially our academic youth, are assumed to be floundering in vast morasses of doubt which these drainage systems will turn into new Edens, wherein man again talks to God face to face. A recent writer, after a long discussion of the question "Does God grow?" decides it in the affirmative, because His human children make progress, on the principle that to encourage their growth either indicates or else stimulates growth in Him. God certainly does appear to be growing upon the epistemologists.

NOTES AND NEWS.

The Munich Congress.

The third International Congress of Psychologists will convene at Munich, August 4-7, 1896. Professor Lipps will preside.

The meetings will be held in four divisions: (1) Psycho-physiology; (2) Psychology of the Normal Individual; (3) Psycho-pathology; and (4) Comparative Psychology. The address of welcome will be delivered in the University Aula on the morning of August 4.

Women are accorded the same privileges as men. The subscription fee is Mk. 15, payable to the Secretariat, Max-Josephstrasse 2 p. t., München, Bavaria. A *Tageblatt*, which will be issued on each of the four Congress days, will supply all needful information on the spot. Titles of papers to be read should reach the Secretariat before May 15.

Further particulars, as to presidents of departments, members of committees, subjects included under departments, etc., may be obtained from any one of the editors of the JOURNAL.

The American Psychological Association.

In the first number of the present volume of the JOURNAL, attention was called to the large proportion of papers, in the programme of the 1894 meeting of the American Psychological Association at Princeton, which dealt with feeling and emotion. The programme of the fourth meeting, held at Philadelphia last December, shows a still greater lack of experimental items. Of the fourteen communications (p. 307) only three were taken from the field of experimental psychology, in the strict sense of the term. One of the others was anthropometrical; four pathological, and one gave the results of a research in comparative psychology. The rest dealt with problems of what is ordinarily called "general" psychology, *i. e.*, with questions of system.

The retirement of the experimentalists,—emphasized further by the proposal to devote a certain amount of the time of each meeting to philosophical enquiries,—cannot but be regretted. At the same time, it is probably inevitable. The understanding of an experimental investigation, and the appraising of its results, demand careful and repeated *reading;* it is hardly possible to follow intelligently, or to offer intelligent criticism, when method and results are thrown into lecture form and the lecture reduced to a compass of twenty minutes. Unless the meetings are allowed to take the form of a conversazione, the apparatus employed shown in their working, and the results made to speak for themselves in charts and diagrams arranged near the apparatus, it would seem that the drift of the Association must continue in the non-experimental direction. It is not that the systematic psychologists are

forcing their way unduly to the front, but rather that the plan and restrictions of the meetings are of a kind to favor them, and to debar their experimentally inclined colleagues from playing any large part in the session.

Bibliographies.

The *Zeitschrift für Psychologie* has just issued its bibliographical index of publications of the year 1894. The list contains 1,504 titles, as against the 1,312 of the *Psychological Index* and the 1,217 of the *Année psychologique*.

Almost at the same time, the *Psychological Index* for 1895 appears, with 1,394 titles. Its publication, within two months of the completed year, is most useful.

It is reported (*Science*, March 6, 1896) that the compilers of the *Psychological Index* and of the bibliography of the *Année psychologique* have joined forces, so that the two lists will in future be identical. This is a step in the right direction. If France and America unite in the production of a rough working list as soon as possible after the conclusion of the year, and Germany publishes, after a reasonable interval, a complete and reliable bibliography of the same year, the objections urged against the existing arrangements in the JOURNAL of October, 1895, will be largely met. There can be no doubt that with more experience on the part of the compilers, the preliminary lists will be made more accurate and be better arranged than they are now.

A New University Course in Psychiatry.

Dr. Adolf Meyer, who was last fall appointed Docent in Psychiatry at Clark University, has, with the kind permission of the Board of Trustees of the Worcester Lunatic Hospital, and of Dr. Quinby, the superintendent, given a short course of lectures and demonstrations at the hospital to students of psychology at Clark University. In former years the lectures on this subject had been given by Dr. G. S. Hall, and illustrative demonstrations of patients were directed by him and by Dr. Quinby. The present course did not pretend to take the same scope as the one of former years. The plan was to give in eight clinics, of two or three hours' duration, a short outline of such neurological and psychiatric problems as allow of clinical demonstration.

One departure from similar courses was the attempt to show just how far we could attribute the various symptoms to known functional and anatomical lesions, where our neurological views began to leave the ground of observation and became mere logical inference, and where we entered upon pure psychology.

The first two clinics were devoted to cases demonstrating the general plan of organization of the nervous system by affections of the "peripheral" and "central" motor and sensory tract—peripheral paralysis, infantile paralysis, lesions of the pyramidal tracts, locomotor ataxia, polyneuritis, hemianæsthesia and hemianopsia in hemiplegia, and physical sensori-motor disorders. The next two clinics dealt with the various forms and stages of general paralysis, leading over to the pure psychoses. Patients with depression formed the subject of the next clinic; they called for an analysis of the various symptom-complexes of neurasthenic hypochondriasis, melancholia, psychoses with fear, delusional insanity with depression, and stupor; an attempt was made to sketch

a plan of investigation of the nosological value of the various psychical features.

The cases of exaltation and of excitement were treated in a similar way, with a view to separate the purely maniacal symptom-complex from that of delirium of confusion and acute dementia. Two clinics were devoted to the types of degeneration, imbecility, degeneration in the period of puberty, paranoia and circular insanity, and the last demonstration covered the field of senile psychoses.

A similar and somewhat more extensive course will be given next year.

The Estimation of Time.

The following instance of accurate estimation of time is worth recording. Last May, while on a rough mountain tramp of about a week, the writer found that one of the party, Mr. Walter E. Magee, Director of Physical Culture in the University of California, was able almost invariably to give the time within a very few minutes without reference to his watch, without looking at the sun, or using any external help. He was quite aware of the power himself, and could to some extent judge what his mental process was, viz., a very swift review and estimate of the lapse of time since he had last known the exact hour and minute: the events and thoughts of the interval, he said, seemed to him a connected chain, not episodic, and measured the space for him very accurately. He would, however, give the time as exactly on waking in the morning as if the interval had been spent in conscious activity; there was certainly, therefore, some sub-conscious estimate involved. He did not receive even unconscious help from the aspect of the light, or any such indication, for the time was given as accurately hours after dark on a cloudy night, or before light in the morning, as in clear daylight. If asked suddenly, at any hour of the day or night, he would require an interval of two or three seconds to make the estimate.

On a second mountain trip I undertook to record the answers given, and compare them with the correct time, with the following results, all recorded promptly either by myself or by one other of the party:

	Actual Time.	Time stated by Mr. M.
June 13, A. M.	8.40	8.40
	9.50	9.40
	10.57	11.00
P. M.	1.20	12.20
	1.52	1.52
	2.33	2.35
	3.39	3.40
	5.43	5.45
	9.08	9.25
June 14, A. M.	4.20	[1] 4.30
	8.14½	8.15
	8.47	8.50
	9.54	9.55
P. M.	2.55	2.45
	3.37	3.35
June 15, P. M.	12.05	12.00
	3.01	3.00
	3.21	3.20
	9.17	[2] 9.20
June 16, A. M.	7.15	7.20
	11.16¾	11.16½
P. M.	1.45	1.45
	2.05	2.07
	2.53	2.54
June 17, P. M.	1.28	1.30
	1.50	1.55
	9.00	9.10
June 18, A. M.	7.10	7.00
P. M.	3.41½	3.45
June 19, A. M.	7.20	[3] 7.30
June 20, A. M.	5.56	5.55
	8.57	8.55
	9.30	9.35
	11.00	11.00
P. M.	3.00	3.00
	10.05	10.00

[1] Given on waking.
[2] Roused suddenly from a doze, and asked the time.
[3] Instantly on waking.

It will be observed that the main difference—the constant one, I mean—between Mr. Magee's estimates and the actual time, is that he guessed in round numbers usually. Where he did not, it was, I think, not so much that he actually brought his estimate down to a point finer than the two-and-a-half minutes required to guess by five minute intervals, but rather as a humorous turn. Still, I think he did not exactly know his own motive in guessing, *e. g.*, 1.52 rather than 1.50, 2.07 rather than 2.05. It will be observed that of the three occasions on which he did not guess in round numbers, two were practically exact guesses.

Mr. Magee did not refer to his watch during these days except to verify the guesses,—did not look at it in the intervals between them, I mean (except in one or two instances, by forgetfulness—not enough to affect the experiment; and even this did not happen at all before the last two or three days).

Notes were kept for a week or so longer, but have unfortunately been lost. The guesses continued as accurate, but betrayed a tendency to follow the variations of Mr. Magee's own watch, which proved on return from the Hetch-Hetchy, where the week was spent, to have changed about a half hour. This was doubtless due to his having verified each guess by it, and thus obtained each time a new starting point for his estimate of the passage of time; and seems to show that his estimate was thus not carried on steadily from day to day, but from hour to hour, and was at bottom based on the watch. This is in accord with his own theory, that he acquired the power of exact estimate of time from the habit of his work, in which everything is exactly timed. Another thing that seems to indicate the same origin of the power, is that during term-time he does not have it, depending on the clock. He himself says that he "cannot do it in the house, when he has his work on his mind." As soon, however, as he is off for an outing, the habit of measuring off time returns.

A Correction.

Dr. R. Watanabe asks us to publish the following:—

"In noticing my paper upon 'Two Points in Reaction-time Experimentation' (this JOURNAL, Vol. VI., 3), M. Binet (*Année psychologique*, 1894, p. 464) makes the following remarks:

"(1) 'Il [the author] donne une soixantaine de réactions d'un sujet (lue-même, probablement.)' I give, as a matter of fact, four tables from three subjects (see pp. 410, 412). And I state (p. 409) that I had at my disposal Professor Titchener's Leipzig material (*Phil. Stud.*, Vol. VIII., 138) and Mr. Hill's and my own Cornell experiments (this JOURNAL, Vol. VI., 2). I also say (p. 411) that my tables were 'chosen at random from a large number.'

"(2) The sentence quoted above continues: '[Un sujet] qui a cherché d'apprecier chaque réaction,' *i. e.*, as the context shows, to estimate its duration. This is not true. I definitely stated that my object was to obtain a qualitative analysis (pp. 409, 410, note), not an estimate of time.

"(3) 'Il [the author] paraît ignorer complètement nos récherches personnelles.' The title of M. Binet's paper is: '*De l'appréciation de la durée dans les temps de réaction.*' No mention of it was necessary, as it dealt with a different problem from that upon which I was engaged. I admit, however, that I might have made my position clearer by instancing M. Binet's article as concerned with that which I had no intention of dealing with."

News.

Dr. W. G. Smith has been appointed Professor of Psychology at Smith College, Dr. H. Nichols, Lecturer in Psychology at the Johns Hopkins University, and Dr. H. C. Warren, Professor of Experimental Psychology at Princeton.

Professor Wundt, yielding at last to the many requests made to him, has prepared an *Outline of Psychology*. The work is intended primarily as a handbook to his lecture course in general psychology.

Professor Baldwin has in the press the second volume of his *Mental Development* ("Interpretations"). Professor Titchener has in the press an *Outline of Psychology*, which aims to do for the junior student in Colleges and Universities what is done by Wundt's *Lectures* for the educated public at large.

Professor E. B. Delabarre takes Professor Münsterberg's place at Harvard University for next year.

Professor E. Hering succeeds the late Carl Ludwig in the chair of Physiology at Leipzig.

Messrs. Macmillan & Co. will publish in 1897 a *Dictionary of Philosophy*, edited by Professor Baldwin. The technical terms employed by experimental psychology will be defined, and their history summarized.

A new philosophical journal, entitled *Kantstudien*, under the editorial care of Prof. H. Vaihinger of Halle, and an international board of assistants, including many distinguished names, is announced by Leopold Voss, Hamburg and Leipzig.

Books Received.

Van Biervliet. Éléments de Psychologie Humaine. Pp. 317, 1895. Alph. Siffer, Gand; Felix Alcan, Paris. Notice in this number.

Conant. The Number Concept; its Origin and Development. Pp. vi-218. Macmillan & Co., New York, 1896. Price, $2.00. Notice in this number.

Fonsegrive. Essai sur le Libre Arbitre, sa Théorie et son Histoire. Second edition. 1896. F. Alcan, Paris. Price, 10 f. Notice in this number.

Lachelier. Du Fondement de l'Induction, and Psychologie et Metaphysique. Two essays in one volume. Pp. 173. F. Alcan, Paris. Price, 2.50 f. Notice in this number.

Martius. Beiträge zur Psychologie und Philosophie. Erster Band, Heft I. Wilhelm Engelmann, Leipzig. Price, 4 marks. Notice in this number.

Thouverez. Le Réalisme Métaphysique. Pp. 282. F. Alcan, Paris. Price, 5 f. Notice in this number.

Weinmann. Die Lehre von den spezifischen Sinnesenergien. Pp. 96. L. Voss, Hamburg und Leipzig, 1895. Price, 2.50 marks.

Wundt. Grundriss der Psychologie. Pp. xvi-392. 1896. W. Engelmann, Leipzig. Price, 6 marks. Notice in this number.

Zwaardemaker. Die Physiologie des Geruchs. Pp. 324. W. Engelmann, Leipzig, 1895. Price, 9 marks. Reviewed in last number.

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ON MUSCULAR MEMORY.

BY THEODATE L. SMITH.

While a vast amount of minute and laborious study has been given to the investigation of the sensory side of psychical activity, experimental research has as yet accomplished relatively little in the realm of central psychology. This is due partly to the fact that in the order of genetic development the senses come first, and partially also to the increasing difficulty of reducing the more complex mental processes to experimental terms.

Memory, imagination, attention, will, and the affective states furnish but short chapters in the history of experimental psychology in comparison with the numerous and sometimes dreary pages which record the patient and painstaking labor of the psychophysicists. Yet it is to these unfinished chapters that pedagogy looks for the aid which it rightfully seeks from psychology, and it is here that psychology must find its practical justification.

The present research was suggested by an incident in connection with Edith Thomas, a child deaf and blind from her fourth year, and, at the time of the incident, about nine years old. This child was tested by Professor Graham Bell of Washington as to her ability to reproduce by motor imitation the movements of the throat and mouth involved in articulate speech. She succeeded fairly well, pronouncing

the letter K, which offers peculiar difficulty to deaf mutes, with unusual distinctness. When asked to repeat the letter some hours later, she called with an almost perfect enunciation, "Kitty, Kitty, Kitty." Investigation revealed the fact that when at the age of four years the gradual loss of speech had followed that of sight and hearing, the last intelligible word spoken by the child was "Kitty." The reproduction was unconscious, the child having absolutely no idea of what she had done. It was not, then, a reproduction of the word as heard or as associated with something seen, but of a muscular movement, which, latent for five years, was recalled by the suggestion of a similar movement. This incident suggested that possibly, under normal conditions, the muscles play a greater part in our memories than we are accustomed to assign to them.

Every teacher has observed children busily moving their tongue and lips during the memorizing of a lesson, perhaps without thinking that the movement was not a mere habit, but a real aid in the process of memorizing. One case has been reported to me of a teacher who reproved a child for moving his lips, and added, by way of explanation, that it was a bad habit and prevented giving full attention to the lesson. Anyone can find in his own experience familiar examples of memorizing done by the muscles; music, of which not a note can be recalled by sight, and whose auditory image is indistinct, may yet reside in the fingers.

The movements of writing, walking, dancing, and repetition of familiar phrases, all tend to become automatic, that is to say, we dismiss them from the higher cortical centres where consciousness is an accompaniment, to the keeping of the lower centres whose functioning is attended by a minimum of consciousness.

In such cases the motor idea itself sinks below the threshold of consciousness and only the expression remains. As to the dependence of the movement for its reproduction on the motor idea, we have only to recall the difficulty which we experience in attempting to make any muscular movement of which we have no previous experience, and therefore no clear mental image of it, in order to realize that the

mental image of a motion and the actual movement are but two sides of one process. Prof. James' familiar statement that we learn to skate in summer and to swim in winter, is an illustration of this. In this connection also, it is an interesting fact noted by Major Powell that those Indian tribes whose religious rites are connected with dancing, say of the uninitiated, "He does not understand it, because he has not danced it out."

These miscellaneous facts were all suggestive that the influence of the muscular or motor element in memory might be reduced to a laboratory problem and investigated by experimental methods.

The amount of experimental work on Memory already accomplished is very small. Investigations of the effect of repetition and rhythm,[1] the memory span,[2] and some comparisons of the relative value of the disparate senses,[3] chiefly sight and hearing, in memory constitute the principal points toward which research has been directed. The Memory of tones has been investigated by Wolfe.[4] The first psychologist to attempt a definite memory problem was Hermann Ebbinghaus, who undertook and carried out in person a series of experiments little short of heroic.

Out of the eleven vowels and diphthongs and the simple consonants of the German alphabet, he formed twenty-three hundred syllables, each composed of a vowel or diphthong between two consonants. These he mixed together, and, picking them up without prearranged order, formed series of varying lengths. His experiments were chiefly upon the memory span and the effects of repetition. His method of learning the syllables was to read aloud in a monotonous voice series of nonsense syllables of various lengths, regulating the rapidity of reading by the strokes of a metronome, until the series could be just reproduced without error. In case of an error, the series was read through to the end and a fresh beginning made. The number of repetitions neces-

[1] Ebbinghaus, "Ueber das Gednächtniss." Leipzig, 1895.
[2] Jacobs and Bryant, *Mind*, XII, pp. 75 seq.
[3] Münsterberg & Bigham, *Psychological Rev.*, Vol. I, p. 453.
[4] Wolfe, "Ueber das Tongedächtniss."

sary for series of different lengths was recorded, and after certain intervals of time, varying from ten minutes to one or two days, or even longer periods of time, the number of repetitions necessary for relearning the syllable was recorded.

By this means he obtained a standard for measuring the degree of forgetfulness. It was found that the process of forgetting was, at first, slow, and then progressed more rapidly, and finally very slowly again. An hour after the series had first been memorized, the process of forgetting had so far advanced that more than half the time originally employed was necessary for relearning the series. After eight hours had elapsed, two-thirds of the original time was required for relearning, and a month later about four-fifths. These numerical relations Ebbinghaus expresses approximately by the following formula: "The quotients of the amounts retained by the amounts forgotten are to each other inversely as the logarithms of the various periods of time that have elapsed."

In memorizing poetry Ebbinghaus found that the verses of a given poem (Don Juan) can be retained ten times as easily as a series of nonsense syllables of similar length. While this precise statement is questionable, it undoubtedly exemplifies the law that associated ideas are far more easily retained than dissociated ones, as in the case of nonsense syllables.

This research of Ebbinghaus remained the only important experimental work on memory until the work of Müller and Schumann (published in 1893 in the *Zeitschrift für Psychologie*). This work was an investigation of the methods of Ebbinghaus. Ebbinghaus' experiments had all been made upon one subject, himself, and without any special investigation of the effects of rhythm and association upon his series of syllables. Müller and Schumann made these points the subject of minute and careful investigation, their experiments extending over a period of nearly five years. The following very brief summary gives the more important results of their work. In series of syllables taken in the promiscuous order of Ebbinghaus, the following effects of association are observable :

Ease of learning is increased,

I. If two or more successive syllables have the same initial consonant;

II. If two successive syllables form a rhyme;

III. If two successive syllables contain the same vowel or diphthong;

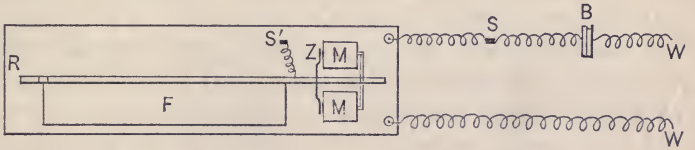
IV. If the final consonant of a syllable is the same as the initial consonant of the syllable immediately following;

V. If two or more syllables form a word or phrase, or if the syllable itself is a word.

VI. Unusual combinations and those especially difficult to pronounce were a hindrance to learning.

VII. Rhythm was found to have a distinctly favorable influence upon learning; syllables which had once formed part of a metrical foot tending to be associated more closely in all future combinations than syllables not so united.

To the authors of all this detailed and laborious work upon the material and method of memory work, the thanks of later investigators are due, and with this material, nonsense syllables, formed and arranged in accordance with the results of Müller and Schumann and altered so as to adapt them to the English language, the first experiments of the present problem were made.



Z = ⟨-shaped piece of metal.
B = battery.
S = switch.
M = magnets.
R = rotating bar.
F = shutter.
S′ = spiral spring.
W = wires leading to clock.

Description of Apparatus.

An automatic shutter, devised by Dr. E. C. Sanford, was used as the means of presenting the different series to the subject. This consisted of a board which could be tilted at any convenient angle, to which was fixed by brass supports a rotating bar. To this was fastened a strip of pasteboard of

convenient size. At the end of the bar were a pair of magnets, brought into connection with the rod by an ⟨-shaped piece of iron.

An electric circuit being made, the attraction of the heaviest part of the metal toward the centre of the magnets caused the rotation of the bar and raised the strip of pasteboard. A light spiral spring fastened to an upright screw regulated the force of the movement, and threw the shutter back when the circuit was broken.

This shutter was electrically connected with a pendulum clock movement, to which were attached two commutators, each consisting of a rubber disc having eighty degrees of brass let into the circumference. Connection was made by two strips of metal fastened to the framework, and so bent as to touch the discs. The clock movement was so adjusted that each disc made one complete revolution in ninety seconds, and in such relation to each other that the circuit was made in one, two seconds earlier than in the other. The former was connected with an ordinary telegraph sounder and the other with the shutter. The clock being set in motion, a warning signal was given to the subject by the sounder, and two seconds later the shutter was raised and remained up for twenty seconds, the warning signal being repeated two seconds before its fall. The clockwork was placed in a separate room, and wires carried across to the shutter, in order that the attention of the subject might not be distracted by the ticking. A switch was introduced into the circuit, so that the interval of the break could be doubled or tripled if desired.

In the present research two points in the problem have been considered :

I. To investigate the complex of throat, tongue and lip movements involved in articulation, and to determine their influence upon the memory of syllables.

II. To investigate the muscle memory proper, *i. e.*, memory of movements.

In carrying out the proposed series of experiments, conditions were made as normal as possible consistently with the demands of experimentation. The subject was comfortably seated in a well-lighted, quiet room and a screen placed be-

tween him and the experimenter, so that extraneous ideas might be excluded as far as possible.

Experiments of the First Series.

The first experiment proposed was to find some means of inhibiting the action of the muscles involved in articulation, in order to compare the series thus learned with those learned under normal conditions.

Various means of inhibiting the movement of the muscles of the throat and mouth were tried. The subject was required to memorize while counting aloud,—one, two, three, one, two, three,—practice being continued until the counting became as nearly automatic as possible. Similar experiments were also tried, using a sustained musical note as the means of inhibition. The syllable *sol* was used as inhibiting action in a greater number of muscles than any other syllable used in musical notation.

In a series of one hundred experiments, each with the counting and sustained musical note, the per cent. of difference in the results was so small as to be practically negligible. The counting was finally adopted as the better method, because unmusical subjects proved to be somewhat diffident about sustaining a musical note, and so required more preliminary practice to overcome the distraction of attention due to this cause.

Each series of syllables was shown for twenty seconds, the subject being requested to repeat aloud as many as he could remember as soon as the shutter was closed. Errors were recorded under three heads :

I. Displacements in the order of the series. II. Wrong syllables. III. Forgotten syllables.

Under this last heading a subdivision into syllables omitted from portions of the series, and those forgotten at the end of the series, was made. This was done for the purpose of checking any tendency on the part of the subject to give more attention to one part of the series than another, the record of errors immediately showing any tendency to devote attention to the first five or six syllables instead of reading the whole series evenly. The subject was always experimented on at

the same hour of the day, and as nearly as possible under the same conditions of health, fatigue, exercise, etc., a record being kept of any deviation from the usual conditions.

The actual experiments from which results have been tabulated were made upon five subjects, one of whom was a trained psychologist, two had had several years of general practice in psychological experimentation, one was entirely unaccustomed to psychological work, and one, though unpracticed in psychological work, was of scientific training in biological work. All were given a sufficient amount of special practice to render the counting as nearly automatic as possible, and to reduce the mean variation of their records to a minimum. The daily hours of experimentation for each person were the same, an important precaution, as the memory curve varies greatly at different hours of the day.[1]

Each subject was given one hundred syllables, that is, ten series consisting of ten syllables each, at one sitting. This number was decided upon after various trials, which proved that a greater number of experiments at one time brought in an element of fatigue which rendered the record unreliable. At first, series with and without counting were alternated, but as this was found to produce interference on account of a tendency of the subject to count during the learning of series to be learned without counting, a change was made to the method of giving ten series with counting on one day, and ten series without counting on the following day. No series was ever repeated, as after once having been recited the auditory element was introduced. A careful record was kept of the physical and mental condition of the subject, and any series showing a marked degree of variation from the normal, which could be accounted for as the result of fatigue, inattention or extraneous disturbance, was excluded from the final averages. Each subject was requested at the close of an experiment to report any introspective observations of chance associations, such as nicknames or suggested words, and especially anything connected with the motor images. Many valuable hints were gained in this way. The following fact

[1] Cf. Bergström, AM. JOURNAL OF PSYCHOLOGY, p. 245.

was reported by all five subjects. At first, the counting produced actual inhibition of the motor image as well as of the overt act. To illustrate this, let anyone try the experiment, quoted by Prof. James[1] from Stricker, of trying to pronounce mentally the word "bubble" with the lips held widely apart so as to effectually prevent any attempt at actual pronunciation, or holding the throat open, as in yawning, attempt to mentally pronounce "giggle." It will be found that at first the mental image is blurred and indistinct. After practice, however, the motor idea became separable from the actual muscular movements, and it became possible to pronounce the syllables mentally with greater or less distinctness, while the muscles through which the motor idea would normally discharge were actually occupied in the movements of counting.

None of the five subjects exhibited the distinct types of visual, auditory and motor memories, so emphasized by Ribot and the French school of psychologists, but two of them, brother and sister, showed a somewhat marked predominance of the motor element, as is shown by the tables, and these two complained of some blurring of the mental pronunciation, especially if the combination of letters was an unusual one, or presented marked difficulty of pronunciation.

The presence of the motor image of the syllables during the counting was also shown by a tendency of the syllables to interpolate themselves in the midst of the counting. Cases of this occurred repeatedly in all five subjects, most frequently in the slight breaks of the counting caused by taking breath, but also at other times. In a few cases, the subject when questioned at the close of a series had no recollection of the interpolation. Whether there was consciousness of the error at the time it was committed cannot be stated, as no questions were asked until after the series had been recited.

The following tables are based on the record of the total number of errors made by each subject for one thousand syllables, the vertical columns showing the number of errors for each series of ten, taken in the order of presentation. The

[1] "Psychology," Vol. II, p. 63.

footing of the vertical columns shows the average error for each day's record of one hundred syllables. The averages taken horizontally give the average of error for the series taken in the order of their presentation, *i. e.*, for the total number of series presented, first, second, third, etc. The summation table shows the percentage of difference in the series due to the counting.

Subject J. P. H. Table showing the errors for 100 series of nonsense syllables with pronunciation inhibited by counting.

Dec. 10.	13.	16.	20.	Jan. 3.	7.	9.	14.	24.	28.	Av.
6	7	8	8	6	8	7	7	9	7	7.3
8	7	9	9	8	8	8	10	8	9	8.4
8	8	8	8	8	8	8	7	10	8	8.1
8	9	8	8	8	10	8	8	8	6	8.1
6	6	8	9	8	8	8	8	8	7	7.6
5	8	7	8	7	6	9	8	8	8	7.4
6	8	8	7	7	7	7	9	8	7	7.4
6	8	7	8	8	9	8	8	8	9	7.9
8	8	9	8	8	8	8	6	8	10	8.1
8	7	8	8	8	10	8	8	8	6	7.9
6.9	7.6	8.0	8.1	7.6	8.2	7.9	7.9	8.3	7.7	7.82

Subject J. P. H. Table showing the errors for 100 series of nonsense syllables under normal conditions.

Dec. 12.	19.	Jan. 8.	10.	15.	16.	21.	22.	25.	29.	Av.
6	5	5	6	7	8	7	7	7	7	6.5
6	6	6	6	7	8	7	5	7	7	6.5
8	8	6	7	5	7	7	5	7	7	6.7
6	5	8	5	7	7	7	7	8	5	6.5
7	6	7	4	8	6	7	6	7	7	6.5
6	7	5	6	6	8	6	8	6	6	6.4
8	7	7	6	6	6	7	6	6	6	6.5
6	6	8	6	7	7	8	6	8	5	6.7
5	7	6	5	5	7	8	7	6	7	6.3
6	6	8	6	5	7	7	6	6	6	6.3
6.4	6.3	6.6	5.7	6.3	7.1	7.1	6.3	6.8	6.3	6.49

Table showing classification of errors given in two preceding tables.

Subject, J. P. H.	(c)					(o)			
	F.	D.	W.	Total.		F.	D.	W	Total.
Dec. 10th	39	4	26		Dec. 12th	38	6	20	
" 13th	56	6	14		" 19th	36	2	25	
" 16th	50	6	24		Jan. 8th	42	2	22	
" 20th	57	7	17		" 10th	38	2	17	
Jan. 3rd	56	6	14		" 15th	37	3	23	
" 7th	57	3	22		" 16th	40	4	27	
" 9th	57	–	22		" 21st	40	4	27	
" 14th	58	3	18		" 22nd	39	3	21	
" 24th	56	6	21		" 25th	40	2	26	
" 28th	51	4	22		" 29th	36	–	27	
	537	45	200	782		386	28	235	649

(c) = series with counting; (o) = normal series; F. = syllables forgotten; D. = syllables displaced; W. = syllables wrong.

Subject E. C. S. Table showing the errors for 100 series of nonsense syllables with the pronunciation inhibited by counting.

Dec. 2.	3.	6.	10.	13.	19.	Jan. 3.	7.	16.	23.	Av.
4	7	7	7	5	3	5	8	5	8	5.9
8	6	8	6	8	6	6	5	5	7	6.5
7	7	6	8	5	4	7	7	6	8	6 5
9	6	8	6	8	6	7	7	4	5	6.6
7	7	9	5	8	5	6	10	7	7	7.1
5	7	10	5	8	7	5	7	7	7	6.8
7	6	8	7	6	8	7	7	8	6	7.0
7	7	8	7	7	6	4	4	7	8	6.5
8	6	7	7	7	8	7	6	6	8	7.0
10	5	8	8	7	4	7	7	8	7	7.1
7.2	6.4	7.9	6.6	6.9	5.7	6.1	6.8	6.3	7.1	6.70

Subject E. C. S. Table showing the errors for 100 series of nonsense syllables under normal conditions.

Dec. 2	5.	6.	9.	12.	17.	20.	Jan. 6.	9.	21.	Av.
4	5	7	5	4	6	3	5	2	5	4.6
5	7	7	5	6	6	4	8	5	5	5.8
7	7	6	7	6	5	4	6	6	5	5.9
7	7	8	5	3	6	6	5	4	6	5.7
6	6	7	6	4	4	5	5	4	4	5.1
7	5	5	7	3	5	6	5	6	5	5.4
7	7	4	5	5	5	7	6	4	5	5.5
6	7	6	4	7	4	6	5	7	5	5.7
7	5	5	7	6	7	4	3	5	4	5.3
8	5	5	4	5	6	4	8	4	5	5.4
6.4	6.1	6.0	5.5	4.9	5.4	4.9	5.6	4.7	4.9	5.44

Table showing classification of errors given in two preceding tables.

Subject, E. C. S.	(c)					(o)			
	F.	D.	W.	Total.		F.	D.	W.	Total.
Dec. 2nd	51	4	17		Dec. 2nd	34	6	24	
" 3rd	25	7	32		" 5th	21	11	29	
" 6th	38	13	28		" 6th	20	11	29	
" 10th	31	6	29		" 9th	23	8	24	
" 13th	27	1	41		" 12th	19	5	25	
" 19th	27	5	25		" 17th	17	1	36	
Jan. 3rd	38	9	14		" 20th	25	7	17	
" 7th	20	9	39		Jan. 6th	12	7	37	
" 16th	23	4	36		" 9th	18	8	21	
" 23rd	29	9	33		" 21st	20	2	27	
.	309	67	294	670		219	66	269	544

Subject E. H. L. Table showing the errors for 100 series of nonsense syllables with pronunciation inhibited by counting.

Dec.7, 9	11.	13.	18.	21.	Jan 2.	6.	9.	15.	18.	Av.
5	5	8	3	6	3	4	2	3	4	4.3
5	4	4	5	4	5	4	3	5	6	4 5
5	7	6	5	6	8	8	5	7	5	6.2
6	6	5	9	8	5	6	7	6	3	6.1
9	5	5	8	6	3	5	5	5	4	5.5
5	6	6	6	4	5	3	5	5	4	4.9
8	7	6	5	6	9	7	4	3	3	5.8
6	6	5	7	5	6	5	4	4	7	5.5
9	6	6	5	5	5	3	5	6	9	5.9
8	5	7	8	9	7	8	5	4	7	6.8
6.6	5.7	5.8	6.1	5.9	5.6	5.3	4.5	4.8	5 2	5.55

Subject E. H. L. Table showing the errors for 100 series of nonsense syllables learned under normal conditions.

Dec.7, 9	12.	17.	19.	23.	Jan. 4.	7.	11.	13.	16.	Av.
4	5	4	4	3	3	1	4	4	2	3.0
2	6	4	5	4	4	2	5	2	4	3.8
7	8	5	3	5	6	3	3	4	5	4.9
7	4	4	2	4	6	2	6	5	6	4.6
5	4	2	3	4	4	5	5	2	2	3.6
6	4	6	2	4	8	6	3	4	7	5.0
5	5	1	3	5	6	5	5	1	1	3.7
5	3	5	5	3	4	5	3	3	6	4.2
4	8	5	5	4	4	5	4	2	5	4.6
5	6	5	4	5	5	1	4	6	4	4.5
5.0	5 3	4.1	3.5	4.1	5.0	3.5	4.2	3.0	4.2	4.19

Subject E. H. L. Table showing classification of errors given in two preceding tables.

Subject. E. H. L.	(c) F.	D.	W.	Total.		(o) F.	D.	W.	Total.
Dec. 7 & 9	50	1	15		Dec. 7 & 9	39	2	9	
" 11th	32	16	9		" 12th	37	2	14	
" 13th	32	10	16		" 17th	31	5	5	
" 18th	41	4	16		" 19th	28	2	5	
" 21st	36	10	13		" 23rd	32	3	6	
Jan. 2nd	45	2	9		Jan. 4th	37	3	10	
" 6th	47	1	5		" 7th	30	1	4	
" 9th	27	9	9		" 11th	33	3	6	
" 15th	35	2	11		" 13th	19	4	7	
" 18th	29	7	16		" 16th	27	3	12	
	374	62	119	555		313	28	78	419

Subject C. G. Table showing errors for 100 series of nonsense syllables with pronunciation inhibited by counting.

Dec. 11.	13.	18.	20.	Jan. 2.	4.	7.	11.	15.	17.	Av.
6	7	10	8	10	9	10	6	7	8	8.1
8	7	10	5	7	7	8	6	7	8	7.3
10	8	7	7	7	7	6	7	8	8	7.5
8	8	8	10	6	10	6	9	6	8	7.9
7	6	10	10	7	6	8	7	6	7	7.4
6	8	7	8	8	7	8	5	7	7	7.2
7	5	7	8	6	9	7	6	5	7	6.7
9	7	9	7	8	8	8	7	7	8	7.8
9	6	10	7	8	8	5	9	7	8	7.7
9	7	7	7	5	7	7	7	8	7	7.1
7.9	6.9	8.5	7.7	7.2	7.8	7.4	6.9	6.8	7.6	7.47

Subject C. G. Table showing errors for 100 series of nonsense syllables learned under normal conditions.

Dec. 12.	14.	19.	21.	Jan. 3.	7.	9.	13.	16.	18.	Av.
5	5	7	6	6	6	6	1	5	6	5.3
8	4	6	7	7	3	6	7	5	6	5.9
7	5	7	5	5	7	6	5	4	7	5.8
7	4	6	7	6	6	8	5	7	5	6.1
7	7	6	3	4	3	4	3	7	7	5.1
4	5	6	7	5	6	6	5	6	5	5.5
5	7	7	7	6	6	4	5	5	5	5.7
5	5	6	6	6	5	7	6	7	7	6.0
7	5	8	8	7	7	5	5	5	7	6.4
4	3	7	7	6	4	5	5	5	6	5.2
5.9	5.0	6.6	6.3	5.8	5.3	5.7	4.7	5.6	6.1	5.7

Subject C. G. Table showing classification of errors in two preceding tables.

	(c)			Total.		(o)			Total.
	F.	D.	W.			F.	D.	W.	
Dec. 11th	66	5	8		Dec. 12th	48	6	5	
" 13th	60	3	6		" 14th	42	3	5	
" 18th	75	3	7		" 19th	53	6	7	
" 20th	70	6	1		" 21st	51	4	8	
Jan. 2nd	60	4	8		Jan. 3rd	49	1	8	
" 4th	66	7	5		" 7th	36	7	10	
" 7th	63	2	9		" 9th	45	–	12	
" 11th	62	1	6		" 13th	33	4	10	
" 15th	62	4	2		" 16th	47	3	6	
" 17th	63	6	7		" 18th	40	1	20	
	647	41	59	747		445	35	91	570

Subject R. G. Table showing errors for 100 nonsense syllables with pronunciation inhibited by counting.

Jan. 26.	28.	30.	Feb. 7.	11.	24.	Mar. 3.	9.	23.	Apr. 3.	Av.
7	7	8	4	7	6	4	4	1	4	5.2
7	6	5	4	3	4	0	1	5	3	3.8
8	8	5	5	6	5	3	4	3	1	4.8
8	9	7	6	6	7	3	8	2	1	5.7
4	4	7	7	7	6	4	4	3	3	4.9
5	4	7	7	7	5	8	4	5	2	5.4
7	4	5	6	8	4	4	4	6	1	4.9
5	5	5	6	7	4	7	3	7	2	5.1
6	6	5	6	7	2	6	6	4	1	4.9
5	5	5	4	3	2	5	8	3	0	4.0
6.2	5.8	5.9	5.5	6.1	4.5	4.4	4.6	3.9	1.8	4.87

Subject R. G. Table showing errors for nonsense syllables under normal conditions.

Jan. 24.	27.	29.	Feb. 10.	18.	25.	Mar. 10.	24.	31.	Apr. 4.	Av.
6	4	5	4	6	4	1	4	2	0	3.6
6	2	4	5	5	5	4	2	3	0	3.6
9	3	4	1	7	4	3	0	0	0	3.1
6	3	5	8	7	4	3	0	0	2	3.8
5	4	6	5	4	4	1	4	3	2	3.8
8	3	4	7	2	4	3	3	2	1	3.7
3	5	1	3	5	3	1	1	1	0	2.3
5	7	6	3	2	0	2	3	1	0	2.9
7	7	6	6	0	4	1	0	0	0	3.1
4	3	4	3	2	3	0	1	4	0	2.6
5.9	4.1	4.5	4.7	4.0	3.5	1.9	1.8	1.6	5	3.25

Subject R. G. Table showing classification of errors given in two preceding tables.

	(c)			Total.		(o)			Total.
	F.	D.	W.			F.	D.	W.	
Jan. 26th	50	1	11		Jan. 24th	38	7	14	
" 28th	39	7	12		" 27th	30	4	7	
" 30th	28	2	19		" 29th	27	6	12	
Feb. 7th	35	2	18		Feb. 10th	29	6	12	
" 11th	34	3	24		" 18th	28	2	10	
" 24th	31	3	11		" 25th	20	3	12	
Mar. 3rd	30	3	11		Mar. 10th	10	1	8	
" 9th	24	7	15		" 24th	8	3	5	
" 23rd	27	–	12		" 31st	8	3	5	
Apr. 3rd	7	2	9		Apr. 4th	4	–	1	
	315	30	142	487		202	35	88	325

SUMMATION TABLE FOR NONSENSE SYLLABLES.

J. P. H.	(c)	69	76	80	81	76	82	79	79	83	77	7.82
	(o)	64	63	66	57	63	71	71	63	68	63	6.49
											D. = 13.3%	
E. C. S.	(c)	72	64	79	66	69	57	61	68	63	71	6.70
	(o)	64	61	60	55	49	54	49	56	47	49	5.44
											D. = 12.6%	
E. H. L.	(c)	66	57	58	61	59	56	53	45	48	52	5.55
	(o)	50	53	41	35	41	50	35	42	30	42	4.19
											D. = 13.6%	
C. G.	(c)	79	69	85	77	72	78	74	69	68	76	7.47
	(o)	59	50	66	63	58	53	57	47	56	61	5.70
											D = 17.7%	
R. G.	(c)	62	58	59	55	61	45	44	46	39	18	4.87
	(o)	59	41	45	47	40	35	19	18	16	5	3.25
											D. = 16.2%	

D. = percentage of difference between series with counting and normal series.
(c) = series with counting.
(o) = series under normal conditions.

A study of these tables shows in all subjects a gradual diminution of error due to practice. An examination of the curves given on pages 473 and 474 shows that in four of the subjects, this was fairly uniform. R. G.'s record, however, shows a very sudden descent of the error curve toward the end. A reference to the dates of the experiments and the fact that during

the latter part of March R. G. served as subject of another research in which the same series of nonsense syllables was used, and received considerable practice in memorizing, furnish an explanation of this deviation from the other results.

The method of each subject was carefully noted, and test series, in which the subject was required to memorize aloud were taken. Although these series were taken primarily simply as a study of method, the quantitative variation for the different subjects due to the addition of the auditory element and emphasizing of the throat movements are so marked that a brief summary of them is given. Five tests, consisting of ten series of ten syllables each, were taken for each subject.

Average error for E. H. L. = 3.30
" " " C. G. = 4.55
" " " E. C. S. = 4.58
" " " J. P. H. = 6.38
" " " R. G. = 2.20

Comparing these results with those given in the previous tables, we find a positive improvement of memory, amounting—

For E. H. L. to 8.9 per cent.
" C. G. " 11.5 " "
" E. C. S. " 8.6 " "
" J. P. H. " 1.1 " "
" R. G. " 10.5 " "

Some allowance must be made in the case of R. G., as these records were taken toward the close of the series of experiments, and were therefore affected by the extraneous practice before mentioned.

It will be remembered that from the beginning no attempt was made to regulate the method of learning the syllables by the introduction of artificial conditions, each subject being left free to pursue the method most natural to him. The number of times the syllables were read during the twenty seconds was therefore dependent upon the individual preference of the subject. The average number of readings for each subject was as follows :

E. C. S., three or four readings during twenty seconds.
E. H. L., two or less " " " "
R. G., rarely more than one reading during twenty seconds.
G. G., two or three readings during twenty seconds.
J. P. H., four or four and a half readings during twenty seconds.

Arranging these results in order of the frequency of reading and comparing them with the percentage of error for each subject, gives the following tables :

	Average Error with Counting.	Average Error in Normal Series.	Read Series.
R. G.	4.87	3.25	1+
E. H. L.	5.55	4.19	2+
E. C. S.	6.70	5.44	3+
C. G.	7.47	5.70	3+ [1]
J. P. H.	7.82	6.49	4+

This result was unexpected, but is so striking as to suggest that the retentiveness which has been ascribed by Ebbinghaus and later experimenters may be due to the amount of time given to each syllable and that the practical problem to be solved for pedagogy is that of distribution of time in relation to the number of repetitions rather than a simple question of the number of repetitions.

While the tables show for every subject an increase of error, varying from 12.6% to 17.7%, due to the introduction of the counting, it still remains doubtful whether the difference can be attributed to the inhibitory effect of the counting upon the muscles, which under normal conditions would furnish the motor expression of the syllables, or to a diversion of attention caused by the introduction of a new factor. This difficulty was fully recognized and various attempts made to meet it. One, which, however, proved unsatisfactory, is noted here, although the test which finally proved most satisfactory is taken up in connection with the later experiments made with the manual alphabet as material. It seemed that if any series could be devised in which the motor idea was originally absent, but might be introduced later, or if this series were of such a character that it could be directly compared with the nonsense syllables series, a verification of the results already obtained might be found.

In any series, whether of figures, letters or syllables, that could be named, the motor idea must be present, therefore the only way of obtaining a series to compare with those already given was to use something which should be unnamed

[1] Toward the close of the experiments this subject changed his method to slower reading.

by the subject. Various Oriental alphabets, and the Braille system used by the blind, were tried, but were all found open to objection. Some were too complicated to be reproduced within the given time, and others suggested objects which could be named. Finally a series composed of a curve and straight lines in different positions was adopted. A complete set of experiments, one hundred series, was carried out with two subjects, but the results were not such as to justify a continuance in the same line. In one subject the percentage of error fell midway between the series with counting and the normal series instead of running parallel with it, as was expected. In the other it differed but a small per cent. from the normal series. This result was evidently due to the imperfection of the material, as it proved suggestive of so many mnemonics that the naming element was by no means excluded. The subject using the most mnemonics had the lesser percentage of error.

A summary of the results derived from an examination of the tables includes the following points :

I. The number of syllables displaced is for every subject less than either of the other two classes of error.

II. For all subjects except one (E. C. S. in the normal series), the number of syllables forgotten exceeds those given wrongly.

III. There are no marked differences in the proportion of three classes of error in the series with counting and the normal series.

IV. The percentage of error is increased to an amount varying from 12.6% to 17.7% for different subjects by the addition of the counting.

In addition to these quantitative results, the study of errors, particularly that of the wrong syllables, furnishes much material that is suggestive. The wrong syllables may be grouped into three classes : I. Those which are mutilated forms of the original syllables. II. Syllables which have been transferred from earlier series, or are mutilations of syllables occurring elsewhere in the same series. III. A residual which can be included in neither of the above classes.

The first class, *i.e.*, mutilations of the original syllables, is the most numerous as well as the most interesting. Displacement of final and initial consonants occur about equally, and these are more numerous than displacements of the vowel.

In several subjects there has been observed a distinct tendency to displace these consonants in accordance with Grimm's law of the interchange of consonants, *i. e.*, *b* and *p*, *t* and *d* are interchanged. Unusual consonants, as final *j* or *h* or initial *x*, are frequently omitted, and in many cases the subject reported something forgotten which was hard to pronounce.[1]

In the study of the second class of wrong syllables, *i. e.*, those transposed from earlier series, great difficulty presented itself, the tracing back of syllables through a large number of series involving much labor and some uncertainty in the results, as syllables similar in sound and spelling were frequently confused. One fact, however, has been clearly deduced : there is a strong tendency of certain syllables to recur in successive series when actually present in only one or at most three series, *e. g.*, one syllable, *ceb*, was found to have been given thirteen times in one hundred series when it actually occurred but twice. This, however, was probably partly due to confusion with the syllable *ced*, which occurred three times during the one hundred series.

The third class of errors, which is numerically the smallest, has yielded no results.

Experiments of the Second Series.

For the second series of experiments an entirely new material was used. This consisted of the printed characters of the manual alphabet. The small cards[2] ordinarily used

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[1] Experiments with series of syllables so arranged as to present special difficulties of pronunciation might furnish interesting results.

[2] These can be obtained from the National Exponent Publishing Co., 69 Lake street, Chicago.

in deaf mute institutions were cut apart and arranged in series of five and ten. *J* and *Z* were excluded, so that with the character &, twenty-five characters indicating positions of the hand were available. These were so arranged that each position occurred the same number of times in ten series, no position occurring twice in the same series.

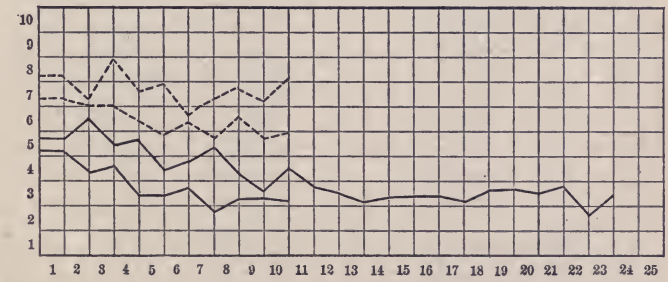
Each subject received sufficient preliminary training to enable him to form the characters with a reasonable degree of facility. The same method of presentation was used as in the case of the nonsense syllables. In the series of five the same intervals, *i. e.*, twenty seconds' exposure and seventy seconds' intermission, were used. In the series of ten, the time of exposure remained the same, but the intermission was doubled to allow for the slower reproduction than in the case of the nonsense syllables. The subject was given at one sitting ten successive series, which he was asked to memorize visually, and to reproduce by forming the characters with his hand as soon as the shutter fell. A series running parallel with this was also taken, in which all conditions remained the same, except that during the twenty seconds devoted to learning the series,the subject was required to form the characters with his hand in addition to the visual reading. These series were taken on alternate days, for the same reason as in the case of the nonsense syllables, *i. e.*, to avoid the interference which occurred when the two series were alternated at one sitting. None of the subjects was familiar with the manual alphabet, and so far as possible the same conditions of experimentation were observed throughout. The same method of recording errors was used as in the experiments with nonsense syllables.

Records were taken on seven subjects, three of whom, E.C. S., E. H. L. and J. P. H., had served as subjects throughout the work with the nonsense syllables. The tables are formed on the same basis as those for the nonsense syllables, the vertical columns showing the errors of the successive series for each day's record, and the horizontal reading the errors of the successive series taken in numerical order for successive days. The summation table shows the decrease in percentage of error for each subject when the characters were

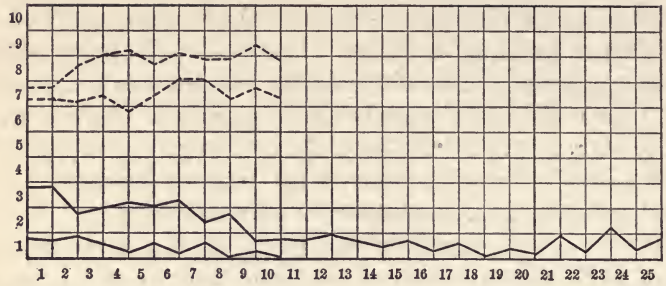
formed with the hand during the learning of the series, and also of a third series, in which the subject was required to count while learning a series visually. This latter series was not alternated with the others, but was taken continuously after the other records were completed. This is more clearly shown by a reference to the curves given on page 474. For the sake of brevity, these series will be referred to as visual and motor series and series with counting.

The curves are plotted on the basis of the total number errors, each point in the curve representing the average error for a series of ten experiments, *i. e.*, for one hundred nonsense syllables or one hundred characters of the manual alphabet, except in series of five, where the calculation is based upon fifty instead of one hundred characters. The figures of the vertical column indicate the number of errors and the horizontal the number of series of ten experiments. The dotted lines represent the curves for the nonsense syllables, the upper curve being for the series taken with counting and the lower the corresponding normal series. The curves formed by the continuous lines represent the manual alphabet series, the upper being for the visual and the lower for the motor series. The continuation of the curve from 10 to 20 shows the effect of the counting on the manual alphabet series, and from 20 onward the effect of discontinuing the counting in diagrams I and II. In V, VI and VIII the counting begins at seven and is discontinued from thirteen onward.

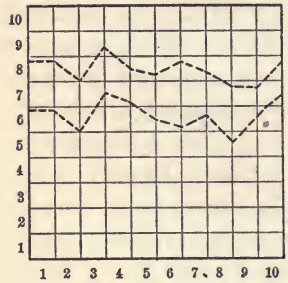
I. Subject E. C. S.



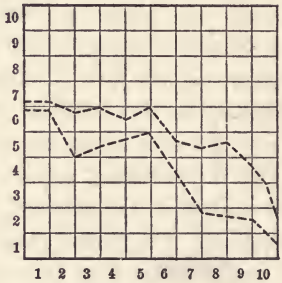
II. Subject J. P. H.



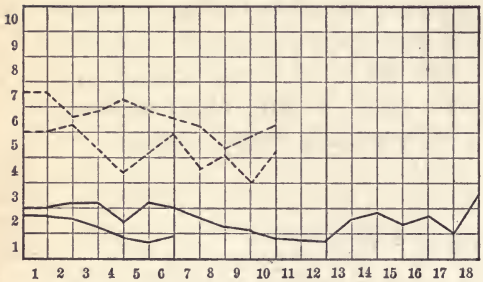
III. Subject C. G.



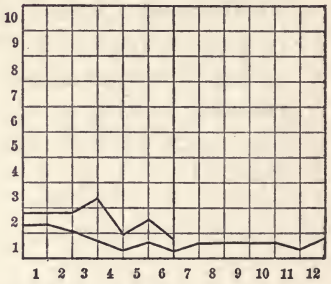
IV. Subject R. G.



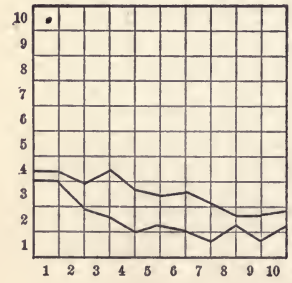
V. Subject E. H. L.



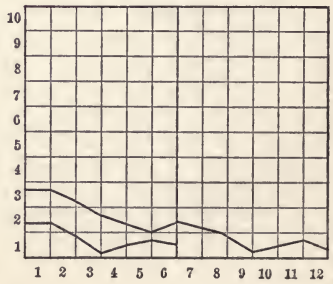
VI. Subject D. H.



VII. Subject A. E. E.



VIII. Subject T. C.



Preliminary record of E. C. S. Series of five.

Motor Series.					Total.	Visual Series.					Total.
Feb. 27.	28.	Mar. 3	7.	10.		F'b. 21	24.	Mar. 2	5.	9.	
0	0	0	1	0	1	1	2	0	0	0	3
1	1	0	0	0	2	1	1	0	1	0	3
0	0	1	0	0	1	2	1	1	0	0	4
0	0	0	0	0	0	2	3	1	1	1	8
1	0	0	1	1	3	2	3	1	0	0	6
0	1	1	0	0	2	2	4	2	0	0	8
2	2	0	2	1	7	3	1	1	2	0	7
0	2	0	0	0	2	3	3	0	1	0	7
1	1	0	2	0	4	2	0	3	0	0	5
2	1	1	1	2	7	4	3	0	0	0	7
7	8	3	7	4	29	22	21	9	5	1	58

Record of E. C. S. Manual alphabet, visual series of ten.

Mar. 13.	19.	24.	27.	31.	Apr. 3.	15.	18.	23.	25.	Av.
3	4	2	4	5	4	3	2	0	0	2.7
4	6	6	2	0	2	2	4	2	5	3.3
5	5	6	6	3	3	3	2	5	2	4.0
7	6	4	4	4	3	4	3	4	4	4.3
4	4	0	8	4	6	6	5	4	4	4.5
5	5	6	5	5	0	6	2	2	4	4.0
7	5	8	3	2	4	5	3	4	5	4.6
6	5	5	2	1	1	2	2	0	5	2.9
3	8	5	7	4	6	3	5	2	1	4.4
3	7	4	6	6	6	7	3	4	5	5.1
4.7	5.5	4.6	4 7	3.4	3.5	4.1	3.1	2.7	3.5	3.98

Record of E. C. S. Manual alphabet, motor series of ten.

Mar. 16.	20	26.	30.	Apr. 2.	4	17.	21.	24.	26.	Av.
2	1	4	0	4	4	1	1	3	0	2.0
4	4	6	0	0	2	0	0	2	2	2.0
3	2	4	2	1	2	1	2	2	2	2.1
5	5	4	2	2	1	1	2	2	3	2.7
5	6	4	3	3	6	3	2	1	3	3.6
4	3	2	3	3	1	3	1	4	2	2.6
6	3	1	3	1	5	3	3	3	2	3.0
5	3	2	3	5	3	3	2	3	2	3.0
4	5	4	5	3	2	2	5	2	2	3.4
4	3	5	3	2	1	2	5	2	3	3.0
4.2	3.5	3.6	2.4	2.4	2.7	1.8	2.3	2.4	2.1	2.74

Record of E. C. S. Manual alphabet, series of ten with counting.

Apr. 28.	29.	30.	May 1.	2.	4.	5.	7.	8.	9.	Av.
0	0	2	2	2	1	1	3	1	1	1.3
3	3	1	0	0	1	1	5	4	2	2.0
4	1	3	2	1	2	2	0	3	3	2.1
4	3	3	2	3	3	3	4	4	2	3.1
2	4	2	2	3	3	2	1	3	2	2.4
3	3	2	3	3	4	3	1	3	2	2.7
3	2	2	3	3	3	2	1	3	4	2.6
4	3	2	3	3	2	3	4	1	4	2.9
3	4	2	3	4	4	3	3	3	2	3.1
3	3	2	3	3	2	2	4	1	2	2.5
2.9	2.6	2.1	2.3	2.5	2.5	2.2	2.6	2.6	2.4	2.47

Preliminary record of A. C. E. Series of five, manual alphabet.

Motor Series.					Total.	Visual Series.					Total.
Mar. 22	23.	25.	28.	31.		Mar. 17	18.	21.	24.	27.	
1	0	0	0	0	1	1	0	0	0	0	1
0	0	0	0	0	0	2	3	2	0	0	7
0	1	0	0	0	1	1	0	2	0	0	3
1	0	0	0	0	1	2	1	3	0	0	6
0	0	0	0	0	0	3	3	1	2	1	10
1	0	0	0	0	1	3	3	1	1	1	9
1	0	1	2	0	4	1	2	3	1	0	7
0	1	0	0	0	1	2	4	2	2	2	12
1	1	0	0	1	3	3	3	0	1	3	10
1	3	0	0	0	4	3	3	0	0	0	6
6	6	1	2	1	16	21	22	14	7	7	71

Percentage of error, 3.2%. Percentage of error, 14.2%. Dif. = 11%.

Record of A. C. E. Manual alphabet, visual series of ten.

Apr. 3.	13.	17.	21.	24.	27.	29.	May 2.	5.	7.	Av.
2	1	3	0	0	0	1	0	0	0	.7
7	5	4	0	3	0	1	0	2	0	2.2
4	2	5	4	3	5	1	4	0	3	3.1
2	4	4	2	2	2	2	0	1	2	2.1
4	4	3	1	3	0	4	0	3	1	2.3
3	4	0	4	2	6	4	2	0	0	2.5
3	1	3	4	3	5	2	4	4	4	3.3
3	3	3	5	2	2	5	6	4	3	3.0
5	3	2	2	4	3	2	5	0	2	2.8
2	2	4	5	3	2	0	1	2	2	2.3
3.5	2.9	3.1	2.7	2.5	2.5	2.2	1.6	1.6	1.7	2.43

Record of A. C. E. Manual alphabet, motor series of ten.

Apr. 1.	4.	16.	18.	23.	25.	28.	May 1.	4.	6.	Av.
3	1	1	0	0	2	1	0	0	0	.8
3	2	2	0	0	0	0	0	1	1	.9
2	2	2	1	1	0	0	1	0	0	.9
2	2	3	0	2	2	1	2	2	1	1.7
4	1	1	0	2	3	1	0	0	0	1.2
3	2	2	1	3	0	0	1	1	0	1.3
3	3	1	2	3	1	1	0	0	0	1.4
3	3	1	1	0	1	2	3	2	4	2.0
4	3	1	3	1	0	1	2	0	3	1.8
3	0	4	2	2	2	2	2	0	1	1.8
3.0	1.9	1.8	1.0	1.4	1.1	.9	1.1	.6	1.0	1.38

Record of J. P. H. Manual alphabet, visual series of five.

Feb. 8.	12.	15.	19.	25.	29.	Mar. 4.	7.	11.	14.	Av.
2	1	2	2	2	2	1	2	0	1	1.5
2	2	0	1	2	1	1	2	0	0	1.1
3	2	2	3	3	2	2	3	2	1	2.3
4	3	0	1	1	2	1	0	0	0	1.2
2	0	3	3	3	3	0	1	1	1	1.7
5	3	3	3	5	1	1	0	2	0	2.3
1	2	2	3	2	3	1	3	0	1	1.8
2	2	2	1	1	4	3	1	0	1	1.7
4	1	2	1	0	3	2	3	1	3	2.0
3	2	3	3	2	1	1	2	1	0	1.8
2.8	1.8	1.9	2.1	2.1	2.2	1.3	1.7	.7	.8	1.74

Record of J. P. H. Manual alphabet, motor series of five.

Feb. 11.	14.	18.	21.	23.	Mar. 3.	6.	10,	13.	17.	Av.
0	1	0	0	2	0	0	1	0	0	.4
0	1	1	2	0	1	1	1	0	0	.7
1	0	0	0	0	0	0	0	0	0	.1
3	3	1	2	1	0	1	0	0	0	1.1
0	1	0	1	0	0	0	0	0	0	.2
1	0	1	1	1	1	1	1	0	0	.7
1	1	1	0	2	0	0	2	1	3	1.1
1	0	2	1	2	1	2	0	0	0	.9
1	0	1	1	0	0	0	0	2	0	.5
1	1	0	1	1	0	1	1	0	0	.6
.9	.8	.7	.9	.9	.3	.6	.6	.3	.3	.63

Record of J. P. H. Manual alphabet, series of five with counting.

Mar. 20.	24.	25.	27.	28.	31.	Apr. 1.	2.	4.	6.	Av.
0	0	0	1	0	0	0	0	0	0	.1
0	0	0	0	0	0	0	0	0	0	.0
2	1	2	0	4	0	0	1	0	0	1.0
1	0	0	0	0	1	2	0	0	0	.4
0	0	1	0	2	0	0	0	0	0	.3
1	2	0	0	0	1	2	0	2	0	.8
1	3	2	1	0	0	0	0	0	1	.8
2	2	0	0	1	0	1	0	0	0	.6
0	1	2	0	0	0	0	0	0	0	.3
0	0	0	2	0	0	0	0	0	0	.2
.7	.9	.7	.4	.7	.2	.5	.1	.2	.1	.45

Record of D. H. Manual alphabet, visual series of five.

Mar. 31.	Apr. 2.	4.	13	15.	16.	Sum.
2	2	3	3	1	0	11
2	2	3	0	0	1	8
0	2	3	1	2	0	8
2	3	2	0	0	2	9
3	0	2	0	1	2	8
1	1	3	0	1	0	6
2	3	2	0	3	0	10
3	1	2	1	2	0	9
2	3	1	4	3	1	14
1	1	2	0	2	1	7
1.8	1.8	2.3	.9	1.5	.7	90

Av. 1.50.

Record of D. H. Manual alphabet, motor series of five.

Mar. 30.	Apr. 1.	3.	14.	16.	17.	Sum.
0	0	0	0	2	0	2
3	2	2	1	0	0	8
1	1	0	0	0	1	3
0	0	0	1	0	1	2
2	2	0	0	2	0	6
1	0	2	0	1	0	4
2	1	0	1	1	0	5
1	1	0	1	0	1	4
1	2	2	1	0	0	6
3	2	1	0	0	0	6
1.4	1.1	.7	.5	.6	.3	46

Av. .76

Record of D. H. Manual alphabet, with counting.

Apr. 24.	25.	27.	28.	29.	30.	Sum.
0	0	0	0	0	0	0
1	1	0	2	0	0	4
0	0	1	1	1	0	3
2	1	0	0	0	0	3
0	1	0	1	1	1	4
1	0	0	0	1	2	4
1	2	0	1	0	0	4
0	0	2	0	1	0	3
1	1	2	0	0	0	4
0	0	1	1	1	1	4
.6	.6	.6	.6	.5	.4	33

Av. .55

Record of E. H. L. Manual alphabet, visual series of five.

Mar. 8.	20.	25.	30.	Apr. 3.	17.		Sum.
1	1	1	1	0	0		4
5	3	2	0	0	2		12
2	1	2	3	2	1		11
1	4	3	0	3	2		13
0	2	3	2	2	2		11
2	0	2	1	2	2		9
4	1	1	0	3	3		12
1	3	3	2	3	4		16
2	4	2	3	3	1		15
2	2	2	3	3	3		15
2.0	2.1	2.1	1.5	2.1	2.0		118

Av. 1.96

Record of E. H. L. Manual alphabet, motor series of five.

Mar. 18.	23.	27.	Apr. 1.	15.	22.		Sum.
1	1	1	0	0	0		3
0	2	1	0	1	0		4
3	3	2	1	2	0		11
1	1	0	1	0	0		3
1	1	2	0	0	1		5
4	0	1	0	1	1		7
3	1	1	1	1	2		9
3	1	1	2	1	2		10
0	0	1	2	0	2		5
0	4	1	2	1	1		9
1.6	1.4	1.1	.9	.7	.9		66

Av. 1.10

Record of E. H. L. Manual alphabet, series of five with counting.

Apr. 25.	27.	30.	May 1.	5.	6.		Sum.
0	1	0	0	0	1		2
1	1	1	0	2	0		5
2	1	1	2	0	0		6
2	1	1	2	1	1		8
2	2	2	0	2	0		8
2	2	1	0	2	2		9
3	1	2	1	0	2		9
2	2	1	1	1	2		9
2	1	2	2	1	1		9
2	1	1	1	0	0		5
1.8	1.3	1.2	.9	.9	.9		70

Av. 1.16

Record of T. C. Manual alphabet, visual series of five.

Mar. 25	30.	Apr. 1.	3.	14.	17.		Sum.
0	1	2	0	0	0		3
1	3	1	1	1	1		8
4	2	2	2	2	2		14
3	3	2	1	0	3		12
3	2	3	4	2	1		15
2	2	3	1	2	2		12
4	2	1	1	0	0		8
3	2	2	0	1	1		9
3	3	1	1	0	2		10
3	3	2	2	3	1		14
2.6	2.3	1.9	1.3	1.1	1.3		105

Av. 1.75

Record of T. C. Manual alphabet, motor series of five.

Mar. 27.	28.	31.	Apr. 2.	4.	15.		Sum.
1	1	0	0	0	0		2
1	1	0	0	1	0		3
2	0	1	2	0	1		6
2	1	1	0	1	0		5
0	2	0	0	0	0		2
1	1	0	2	1	1		6
3	1	0	0	1	0		5
1	1	1	0	0	0		3
1	0	2	1	1	1		6
1	1	2	0	1	0		5
1.3	.9	.7	.5	.6	.3		43

Av. .71

Record of T. C. Manual alphabet, series of five with counting.

Apr. 24.	25.	27.	28.	29.	30.		Sum.
1	0	0	0	0	0		1
1	0	0	0	0	0		1
1	1	0	1	1	2		6
1	1	1	0	0	1		4
2	1	0	0	0	0		3
1	1	0	0	2	0		4
1	1	0	0	1	0		3
1	1	1	0	0	0		3
1	1	0	1	2	1		6
2	2	1	2	0	0		7
1.2	.9	.3	.4	.6	.4		38

Av. .63

SUMMATION TABLE FOR THE MANUAL ALPHABET SERIES.

												Av.
E. C. S.	V.	47	55	46	47	34	35	41	31	27	35	3.98
	M.	42	35	36	24	24	27	18	23	24	21	2.74
	C.	29	26	21	23	25	25	22	26	26	24	
											D. = 12.4%	
A. C. E.	V.	35	29	31	27	25	25	22	16	16	17	2.43
	M.	30	19	18	10	14	11	9	11	6	10	1.38
											D. = 10.5%	
J. P. H.	V.	28	18	19	21	21	22	13	17	7	8	1.74
	M.	9	8	7	9	9	3	6	6	3	3	.63
	C.	7	9	7	4	7	2	5	1	2	1	
											D. = 22.2%	
								Sum.		Av.		%
D. H.	V.	18	18	23	9	15	7	90		1.5		30.0
	M.	14	11	7	5	6	3	46		.76		15.3
	C.	6	6	6	6	4	5	33		.55		11.0
											D. = 14.7%	
E. H. L.	V.	20	21	21	15	21	20	118		1.96		39.3
	M.	16	14	11	9	7	9	66		1.10		22.0
	C.	18	13	12	9	9	9	70		1.16		23.3
											D. = 17.3%	
T. C.	V.	26	23	19	13	11	13	105		1.75		35.0
	M.	13	9	7	5	6	3	43		.71		14.3
	C.	12	9	3	4	6	4	38		.63		12.6
											D. = 20.7%	

V. = visual series.
M. = motor series.
C. = series with counting.
D. = difference in % of error between visual and motor series.

TABLES SHOWING CLASSIFIC'N OF ERRORS FOR MANUAL ALPHABET.

Record of E. C. S.

MOTOR.			VISUAL.			COUNTING.		
F.	D.	W.	F.	D.	W.	F.	D.	W.
1	8	12	4	15	16	2	13	14
3	11	10	1	13	13	–	12	14
1	12	10	1	17	13	–	10	11
2	6	10	2	27	12	–	11	12
–	16	11	3	15	17	1	11	13
3	10	11	–	19	15	–	11	14
1	18	5	2	22	23	–	10	12
5	22	9	4	25	17	–	10	16
1	21	13	1	33	21	–	13	13
2	25	15	3	25	19	–	12	12
19	149	106	21	211	166	3	113	131

F.= characters forgotten; D.= characters displaced; W.= characters wrong.

Record of A. C. E.

MOTOR.			VISUAL.		
F.	D.	W.	F.	D.	W.
–	5	5	–	8	9
–	3	3	1	7	8
1	3	7	1	9	6
–	3	6	2	12	8
1	6	4	2	16	7
3	7	4	3	13	9
–	4	6	3	12	10
7	5	6	7	16	8
7	5	7	14	9	6
8	3	19	9	8	18
27	44	67	44	110	89

Record of J. P. H.

Motor.			Visual.			Counting.		
F.	D.	W.	F.	D.	W.	F.	D.	W.
1	5	3	16	2	10	–	3	4
4	–	4	6	3	9	–	3	6
3	1	3	6	3	10	1	3	3
3	1	5	3	8	10	–	1	3
4	3	2	7	7	7	–	4	3
1	1	1	4	8	10	–	–	2
–	2	4	3	2	8	–	1	4
1	1	4	1	3	13	–	–	1
–	3	–	–	–	7	–	–	2
1	–	2	–	–	8	–	–	1
18	17	28	46	36	92	1	15	29

Record of D. H.

Motor.			Visual.			Counting.		
F.	D.	W.	F.	D.	W.	F.	D.	W.
5	4	5	5	4	9	3	2	2
2	4	5	8	2	8	3	1	2
2	2	3	5	4	14	2	–	4
4	–	1	1	5	3	1	2	3
3	1	2	5	2	8	–	–	4
–	–	3	1	4	2	–	2	3
16	11	19	25	21	44	8	7	18

Record of E. H. L.

Motor.			Visual.			Counting.		
F.	D.	W.	F.	D.	W.	F.	D.	W.
–	8	8	–	14	6	8	5	5
4	1	9	9	1	11	6	2	5
2	3	6	14	1	6	7	1	4
6	1	2	7	2	6	2	2	5
6	–	1	13	4	4	4	2	3
6	–	3	10	6	4	4	3	2
24	13	29	53	28	37	31	15	24

Record of T. C.

Motor.			Visual.			Counting.		
F.	D.	W.	F.	D.	W.	F.	D.	W.
7	1	5	10	5	11	–	2	2
4	3	2	4	10	9	1	1	4
4	1	2	5	8	6	1	–	3
–	2	3	–	1	10	1	–	2
–	2	4	2	3	8	1	3	5
–	1	2	2	4	7	2	2	8
15	10	18	23	31	51	6	8	24

As in the experiments with the nonsense syllables, a study was made of the method of each subject, both from introspective report and the character of the errors.

E. C. S. showed the strongest tendency to mnemonics. There was at first an inclination to give names to the various characters, but this was resisted as introducing a source of error. Open and closed positions of the hand or the number of fingers pointing upward or downward, were then used as a means of classification. Later, a spatial mnemonic was strongly developed, the first and last and fifth and sixth positions being used as points of fixation. An incipient tendency to form the characters with the hand during the learning of the visual series was noticed, and after the characters became familiar, the subject occasionally could not remember whether in the series where motions were required the motions had been made or not, although, at first, a special effort was required to make them, and they were felt to be a hindrance to the visual learning. The preliminary record of the subject, however, shows 11.6% less of error for the motor series than for the visual. In the final record the difference in favor of the motor series was reduced to 11%. The change of method noted for the later series of nonsense syllables to a slower reading of the series was continued in the learning of the manual alphabet series, the series being read from two to two and one-half times during the twenty seconds of exposure. It is to be noted that the total number of errors is less and the relative number of displacements greater than

in the series of nonsense syllables. The smaller number of characters employed would seem to furnish a reason for this result, but the same relation did not hold for all subjects.

Subject A. C. E. A preliminary record taken with a series of five characters, showed a difference of 11% in favor of the motor series. The difference is reduced to 10.5% in the final record taken with a series of ten. There was with this subject a distinct consciousness of the advantage gained by introducing the motor element, and a much greater degree of confidence was shown in the motor than in the visual series. There was a strong tendency to make the movements during the learning of the visual series. In some instances there was a conflict between the visual and motor images, the statement being made, "It looks like this, but it feels like this." Although decision was sometimes made in favor of the visual image, the motor image was in the majority of cases the correct one. This subject was remarkable for the persistence of the memory images, being able to recall a series after considerable intervals of time had elapsed. In one case a series was correctly recalled after an interval of two hundred and seventy seconds, the time of exposure having been twenty seconds. In the later experiments the method of this subject was chiefly elimination, the possible characters being formed with the hand, and decision, guided partly by the feeling of the hand and partly by the visual image, called up simultaneously with the movement. The series was rarely read through more than once, and in some cases a series had to be thrown out because the subject failed to read it to the end. This record has the least percentage of error found in any case, showing for the motor series only 138 errors for one thousand characters, and for the visual series only 243 errors for the same number.

Subject J. P. H. Little conscious aid was derived by this subject from the introduction of the motor element, except in the practice series, when it at first seemed a help, the feeling of position seeming to reinforce the visual image. Later as the motions became more automatic, they seemed to the subject more of a hindrance than a help in so far as they were noticed at all. The record, however, shows a difference of

22.2% in favor of the motor series, and an incipient tendency to motion was especially marked. In a large number of cases the character was either partially or completely formed by the hand several seconds before it was recalled visually, and in a number of cases the character was correctly formed by the hand, but given up as forgotten by the subject. No visual attention was given to the hand by any subject after the first few practice series.

Subject D. H. This subject made from the first a strong effort to exclude all forms of mnemonics, and to make the memorizing purely visual. The making of the characters was a conscious effort, and in no case was the tendency to form the characters unconsciously, noted. The average number of times of reading the series was two and one-half.

Subject E. H. L. The introspective report of this subject shows the visual image to have been most prominent in consciousness, though during the motor series, the motor image was occasionally distinguished. Little use was made of mnemonics, though the relative positions of the characters were sometimes used as a means of recall. Attempts at naming were very infrequent, though occurring in a few cases.

Subject T. C. This subject showed a slight tendency toward naming the characters, and a somewhat uneven distribution of attention was noted, any character which appeared difficult receiving more attention. In the series in which the characters were not formed with the hand, the visual image was the only one noticed by the subject, and no case of unconscious reproduction of the characters was noted. In the motor series the motion of the hand followed the visual idea without consciousness of effort, but in no case did the motion precede the visual image. The average number of readings given to the series was two and one-half times.

The memory span of each subject was originally tested by a graded series, and in cases where great variability in the results occurred from the use of the longer series, the series of five was used as giving more satisfactory results, although preventing a direct numerical comparison with the series in which ten characters were used. A study of the distribution

of error, and comparison with the nonsense syllables series for each subject, gives the following results:

For E. C. S. displacements are more frequent than wrong characters in both visual and motor series. In the series of nonsense syllables, the reverse was the case. The absolute number of errors is less than in the series of nonsense syllables.

For A. C. E. in the motor series the displacements are more numerous than wrong characters; in the visual series the wrong characters are the more numerous. This accords with the fact that the motor consciousness was very strong in this subject.

For J. P. H. the wrong characters were more numerous in both the visual and motor series and the same was true for both series of nonsense syllables.

For D. H. wrong characters were more numerous than displacements in both motor and visual series.

For E. H. L. wrong characters were more numerous than displacements in both motor and visual series, and the same was true for the two series of nonsense syllables.

For T. C. wrong characters were more numerous than displacements in both motor and visual series.

The total number of errors for subjects having records for both nonsense syllables and manual alphabet series is, in all cases, less in the manual alphabet series, though in the case of E. H. L. the records are not numerically comparable. The smal er number of characters available for the latter series, in part, accounts for this.

There is, in the manual alphabet series, an increase of error in the second half of a series of ten experiments. (One exception to this occurs, T. C. in the visual series.) That this is probably due more to interference than fatigue is shown both by the introspective report of the subject and the record of errors.[1] Positions of the hand which have occurred in previous series were introduced, frequently in the same serial

[1] Cf. Bergström, "Experiments upon Physiological Memory by Means of the Interference of Associations," AMERICAN JOURNAL OF PSYCHOLOGY, V, 1892-93, 356 ff., and VI, 1893-95, 267 ff.

position which they occupied in the original series. Also, if in any case a series was shown and partially learned, but thrown out in consequence of some violation of experimental conditions, the characters of this series showed a tendency to recrudescence throughout the remaining series of the experiment.

The summation table shows for the motor series a percentage of error varying from 10.5% to 22.2% less than in the case of the visual series.

A study of the characters given wrongly was also made, as in the case of the nonsense syllables. All the errors were counted and tables made showing the number of times each letter occurred in place of another.

No quantitative result has been derived from this tabulation, but a careful comparison with the positions of the hand represented by the letters discloses three well-marked groups of errors:

I. Errors arising from similarity, in which the wrong letter bears either a visual or a motor resemblance to the correct letter. In those bearing a visual resemblance, the naming element is probably present to some extent, a classification into open and closed positions of the hand being made. In some cases, this seems to take the form of contrast, a pairing off of letters formed by opposite motions taking place, *e. g.*, q and g. The interchange of b and m, which have no likeness visually, furnishes an example of motor similarity, as may be readily tested by forming the letters with the hand.

II. Those letters which have occurred in the same serial positions in earlier series tend to recur as errors in later series. This class of errors increases in the later members of ten successive series, and the error tends to repeat itself after having once occurred. This was most marked when a series partially learned, or accidentally seen, was thrown out, the letters of such a series persistently intruding themselves into those given later, as if, having failed to find their proper motor discharge, there was an interference with the later mental images.

III. After all errors which can be classified under either of the preceding rubrics are excluded, there is a residual for

which no explanation, save that of chance occurrence, is apparent.

During the experiments with the manual alphabet above recorded, it occurred to the writer that these series might be utilized as a test of the automatic character of the counting in the series of nonsense syllables. The manual alphabet furnished a visual series, in which the naming element was at a minimum, and the motor element introduced through muscles, in which counting could produce no interference. If, then, the difference in error found in the series of nonsense syllables were due to a distraction of attention, the same result should occur in the manual alphabet series.

Five subjects were experimented upon, three of whom were also subjects of the experiments with nonsense syllables. Reference to the tables and to the curves given on page—— show the result. In every case the curve shows a slight but well-marked decrease of error, which may be fairly interpreted as a continuation of the effect of practice. A still more noticeable fact is the smoothing out of the curve. Reference to the tables will show that not only is the variation in the curve from day to day greatly lessened, but the mean variation of the daily record for each series of ten experiments is also reduced, indicating that the counting actually steadied rather than distracted the attention. With three of the subjects, experiment was continued for a few days with a cessation of the counting. One subject shows a decided rise in the error curve, and in all three the variation from the smoothing out of the curve during the counting is marked. From these results the conclusion seems justifiable that the difference found in the two series of experiments with nonsense syllables was due not to a distraction of attention caused by the introduction of a new factor, but to the inhibition of the motor expression.

As a conclusion from the various experiments represented in this study, can it be fairly assumed that out of the memory complex, the motor element has been quantitatively differentiated and its exact influence measured? To the question in this form the answer must be no. The parallel series were made, as nearly as might be for experimental purposes, to

differ only by the one condition of the introduction of a motor element, but the motor element was by no means excluded from the series called visual, but which was, in reality, a complex of visual, auditory and motor images, for though actual muscular movements were absent, the idea of movement was never entirely excluded, as was shown by the report of the methods used by the various subjects. The difference between the series, then, is not to be explained as a difference between a complex of visual, auditory and motor elements, in which the visual element predominates and a similar complex to which the expression of the motor idea is added.

To those who have served as the subjects of the prolonged and tedious series of experiments, I wish to take this opportunity of expressing my hearty thanks, and especially to Dr. Sanford, who has not only served as subject of the experiments throughout the year, but has furnished constant inspiration by his interest and helpful suggestions.

A PRELIMINARY STUDY OF SOME OF THE MOTOR PHENOMENA OF MENTAL EFFORT.

By Ernest H. Lindley,

Fellow in Psychology, Clark University.

These pages represent the result of an examination of data gathered by questionnaire and by direct observation, dealing with some of the motor phenomena of mental effort. Chief attention is devoted to the study of those postures and movements, rich in variety and little understood, namely, "common motor automatisms."

The following cases from the questionnaire reports will furnish a more definite idea of the material studied. "When studying I often find myself playing with pencil, holding it first on one end and then on the other, or twirl watch-chain. Often look steadily at some distant point, and at such times often squint and slightly frown." Another person "when thinking, frowns, moves uneasily on chair and bites finger nails." A third "always scratches head before attempting anything difficult."

It must be noted that the word "automatism" does not here have the more narrow and technical connotation ascribed to it in psychological texts. Here the term is made to include not only some movements initiated from within, but also many set going from without. It comprehends all tricks and peculiarities of movement and posture, whatever their origin, which have become more or less unconscious, and which accompany mental effort. No attempt is made to separate these common automatisms from the so-called normal expressions of mental effort, partly because the line of demarkation seems a vanishing one, and largely because both classes of phenomena must be studied in their relations to each other if either is to be understood. Both belong to a somewhat neglected chapter of psychology, and both sustain highly important relations to fundamental problems. They may not only

throw new light on the nature of attention and its mechanism, but also furnish important data with regard to mental development.

Returns from the Questionnaires.

The materials for this study were from three sources:

1. Most of the data were observations sent in response to a part of President Hall's Syllabus X (series '95). The topic in question reads as follows:

III. *Effort Automatism.* Describe the unconscious acts that accompany work or fixed attention—as during recitations,—as biting tongue or lips, chewing a stick or nothing, winking and blinking, twisting buttons, handling articles of dress, playing with fingers, swaying, rocking, rising on the toes, standing on the sides of the feet, turning away, fixating a distant point with the eyes, wriggling, writhing, tapping, drumming, scowling, squinting, tics, grimaces, pulling finger to snap the joints, moving the ears, putting finger in the mouth; whistling, singing and dancing at work. What indicates the hardest effort — as the fidgets or habit chorea seen just before great athletic feats — shutting eyes or ears, moving lips; tunes, verses, etc., persistently running in the head? Is the fœtal posture approached? Does fatigue increase or diminish these movements? Order and per cent. of frequency and duration? Should some be encouraged for better work? At what age are they most common? Treatment?

2. A smaller number of replies to a part of question II of the syllabus issued by President Hall and Dr. Lukens, entitled, "The Beginnings of Reading and Writing." The points in question were as follows: Describe (1) accessory, automatic movements of tongue, lips, hands, eyes, head, legs, feet or body, while writing; (2) ditto while reading.[1]

3. Observations made by the writer, with the coöperation of Dr. Hall in the kindergarten and primary grades of the Boston Normal Training School.

The total number of cases reported was 662. This does not represent, however, the number of persons represented, inasmuch as the same individuals were observed at different times, and therefore each separate record constitutes a case.

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[1] Nearly all the data in reply to the above syllabi were gathered under the able direction of Miss Lillie A. Williams, by the members of her classes in psychology, at the State Normal School, Trenton, N. J. The collection of such data is made a special feature of the child-study pursued there, and the very great care with which the work is done is shown by Miss Williams' article, "How to Collect Data for Studies in Genetic Psychology," in the *Pedagogical Seminary*, Vol. III, No. 3. Our returns, therefore, possess high value, and their great importance in this study is gratefully acknowledged.

While it would be of great advantage to know exactly the number of persons reported on, the replies to the questionnaires were often of such a nature as to preclude accurate determination of this point. Of these 662 cases 235 were of children twelve years of age or under. Of the remaining 427 cases, nearly all are under twenty years of age, the ages sixteen to nineteen furnishing more than half of the 427 cases. We have named the group containing all those over twelve adolescent, inasmuch as it includes only twenty-seven adults, nineteen of whom are men and eight women.[1]

Of the total 662 cases, 421 were females, 241 males. Of the 235 children, there were 117 girls and 118 boys. Of adolescents, 304 were females, 125 males.

The grouping of the automatisms has been a point of considerable difficulty. The system chosen is manifestly rough and imperfect, but was determined as far as possible by the nature of the actual returns. It is as follows: —

Head: Held on side, move sideways, move up and down, move with pen, jerky movements, move.

Face: Grin, grimace.

Eyes: Fixed, wink, close, twitch, roll, squint, bulge.

Ears: Move.

Forehead: Wrinkle, frown.

Mouth: Twitch, drop corners, chew, move.

Jaw: Bite, chew, put objects in, clench, move sideways.

Lips: Draw in and out, pucker, move, work, bite, press, twist, suck, chew.

Tongue: Protrude, move sidewise, move in and out, move with pen, bite, chew, roll, in one cheek, suck.

Hands: Play, clasp, clench, rub or scratch, put in pockets, wriggle, pull hairs, etc., twist hair, smooth, put objects in, move.

Fingers: Play, drum, mark on paper, move up and down, point, move, snap or pull.

Arms: Fold and unfold, jerky movements.

Body: Sway, twist, shrug shoulders, fidget, rock, turn away, move.

Legs: Cross, move, move knees, twist, raise heel, twist heel.

Feet: Sides of feet, stand on one foot, right on left, left on right, rise on toes, rock, lift one foot, move, stamp, wriggle, cross, tap, shake.

The movements and postures are thus distributed among

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[1] This inclusion, as adolescent, of women over twenty-one and of men over twenty-five, is open to criticism, but the numbers are very small, and make practically no difference in the results.

ninety-two classes. Forty-five of these represent the region of the head, twenty the feet and legs, nineteen the hands and fingers. This latter number does not show adequately the relatively great variety in movements of hands and fingers, inasmuch as the classification here was more general.

The following table is designed to exhibit the distribution of automatisms among the different parts of the body, as well as to show the order of frequency of automatisms in children as compared with adolescents.[1] In the last column of the table appears the order in which the automatisms of children preponderate over similar ones of adolescents. The last five items are followed by the minus sign, to indicate that in these classes the automatisms of children are less frequent than in adolescents. In all the others, as indicated by the plus sign, the children show the largest number, those of the head having greatest advantage, mouth next, and so on. This is important as roughly indicating the shiftings of the locality of the automatisms due to age. The numbers with which all the tables deal are manifestly too small to render the ratios anything more than suggestive. The difficulty of observing all the expressive movements of an individual at any given time, is very great, and when we reflect that a large number of cases reported are results of self-observation of these, at best, only semi-conscious movements, it appears highly probable that our totals are too small. Some movements, moreover, such as slight pressure of the lips, contractions of muscles of covered parts of the body, and the like, elude observation more easily than the larger muscular contractions. This source of error tends to narrow the variety of automatisms. Both the above mentioned defects, then, produce underestimation rather than overstatement of the actual phenomena.

In the first part of the table, the numbers opposite each item represent the number of given automatisms in a thousand. In these calculations 1,000 is used as a basis instead of 100 (as in percentage), simply for convenience, in that it yields larger numbers and fewer fractions, without, of course, destroying the original proportion. The method of calculation is as follows. The children, for instance, show thirty-eight body automatisms. This number is divided by 897, the total number of automatisms from all sources, and the result is multiplied by ten, yielding forty-two, which represents the number of cases of body automatisms in a thousand autom-

[1] In the discussion of the tables, the word automatisms is used for convenience, to designate expressive movements as well as common motor automatisms.

TABLE I.

Relative Frequence of Automatisms.

	I Ch.	II Ad.	III Ch. (1.81)	IV *A*	Order of frequency in children.	Order of frequency in adolescents.	*A'*
Fingers	81	143	146	102	Fingers	Fingers	Head+
Feet	72	57	130.3	228	Feet	Feet	Mouth+
Lips	71	53	128	241	Lips	Eyes	Legs+
Tongue	57	26	103	396	Tongue	Lips	Tongue+
Head	48	8	86.8	1085	Head	Hands	Face+
Body	42	33	76	230	Body	Jaw	Lips+
Hands	32	49	57.9	118	Hands	Forehead	Body+
Mouth	20	6	36.2	603	Mouth	Body	Feet+
Eyes	15	56	27	48	Eyes	Tongue	Hands+
Jaw	13	49	23.5	47	Jaw	Head	Fingers+
Legs	6	2	10.8	540	Legs	Mouth	Arms—
Forehead	5	34	9.05	26	Forehead	Legs	Eyes—
Face	3	2	5.43	271	Face	Face	Jaw—
Arms	1	2	1.81	90	Arms	Arms	Forehead—
Ears		2			Ears	Ears	Ears—

Explanation of Table. Columns I and II represent children and adolescents respectively, and indicate the number of given automatisms per thousand. In column III, the ratios of I are multiplied by 1.81 in order to render the numbers for children more easily comparable with those of adolescents; there being 1.81 more adolescents than children reported. In IV *A* is expressed in percentages the proportion of children's automatisms to those of adolescents. For instance, in "fingers," children show 146, while adolescents furnished only 143. The 146 of children is 102% of the adolescents, etc. In *A'* these percentages are arranged in order and the *plus* sign indicates preponderance in favor of children; *minus* sign indicates preponderance of given automatisms in adolescents. The remaining columns show the order of frequency of the different automatisms in children and adolescents respectively.

atisms observed. The average number of automatisms per hundred children is 176, of adolescents 110. If, however, we subtract all the cases of "writing" and "reading" automatisms reported at another time, in addition to those observed by the present writer, the average for the children is reduced to 124, while the adolescent average remains 110.

Let us now consider briefly some of the more striking details. About half of the total number of automatisms belong to parts of head and face. Of single groups recorded, however, "fingers" and "feet" lead in both children and adolescents. In the latter "fingers" show a great advantage over the other automatisms. The "feet" automatisms, however, especially in children, include many cases of mere posture rather than of movement, as standing on sides of feet, and the like. The "lips" rank high in both lists. The connection of these muscles with speech as well as with the gustatory mechanisms would lead us to expect high rank in the table. In the order of greatest relative frequency in children as compared with adolescents, those of "head" show a very great predominance, while those of "mouth," "legs" and "tongue" also exhibit considerable advantage. Of the two most prominent groups in each list—those of "fingers" and "feet,"—it seems evident that there is little decline due to age. The growing relative importance of "eyes" and "forehead" is significant. These are considered the intellectual muscles par excellence, and the above figures indicate the gradual settling of expression in the face. The relative prominence of body automatisms is slightly obscured by the large number of head movements and postures, which are introduced by the writing, reading and kindergarten groups. Of these body automatisms, the most frequent is swaying, and nearly all the cases reported are of children. Playing and drumming with fingers are not so frequent with children as among adolescents. This may be due to the fact that children have as yet no very great ability to make the finer movements of fingers.[1] As between boys and girls, the latter lead greatly in swaying the body, and considerably in finger automatisms, while the boys show greater frequency of tongue, feet and hand movements. Some of these facts are perhaps explainable as due to the greater conformity on the part of the girls to social custom, which would tend to gradual suppression of the more marked of such movements. The average number of automatisms per 100 girls is 179, of boys 181. The quantitative differences

[1] "Development of Voluntary Motor Ability," Bryan (AM. J. PYSCH., Vol. V, No. 2), and "Preliminary Study of Motor Ability," Hancock (*Ped. Sem.*, Vol. III, No. 1).

TABLE II.

Classification of Automatisms According to the Activity that they Accompany.

Writing.		Reading.		Reciting.		Public recitation.		Conversation.		Attention; interested.		Studying.		Difficult recollection.		Greatest effort.	
Lips	240	Body	240	Feet	253	Fingers	433	Fingers	421	Feet	196	Fingers	197	Eyes	339	Lips	238
Tongue	220	Head	180	Fingers	190	Body	170	Hands	131	Fingers	175	Hands	120	Hands	190	Hands	195
Head	170	Hands	140	Body	166	Eyes	170	Forehead	105	Hands	163	Jaw	120	Lips	127	Forehead	173
Feet	170	Fingers	140	Eyes	130	Hands	113	Legs	105	Lips	103	Lips	116	Body	84	Eyes	86
Mouth	87	Feet	110	Hands	120	Feet	56	Eyes	78	Eyes	93	Eyes	73	Head	63	Jaw	65
Forehead	24	Lips	55	Jaw	47	Head	18	Jaw	78	Forehead	92	Feet	67	Forehead	63	Fingers	65
Body	24	Tongue	36	Forehead	23	Jaw	18	Body	52	Jaw	91	Tongue	64	Fingers	63	Feet	43
Legs	24	Arms	18	Lips	23	Lips	18	Head	26	Legs	21	Body	55	Feet	63	Tongue	43
Jaw	14	Jaw	18	Head	15					Body	21	Forehead	43	Jaw	60		
Hand	4			Face	15					Head	10	Legs	30	Face	21		
Fingers	4			Arms	15					Ears	10	Face	12	Mouth	21		
												Head	8	Tongue	21		
												Arms	8				
												Ears	4				
Number of cases.	96		28		109		44		28		47		170		29		30
Average per hundred.	214		180		110		120		100		136		130		160		150

The columns read vertically exhibit the order of frequency of the different automatisms, the numbers opposite the items representing the ratio of the frequency of the given automatism on a basis of one thousand.

due to sex are thus so slight that they are disregarded in further treatment of results.

In order to determine the effect of various kinds of activity and of posture resulting therefrom, the following groups were made, namely, automatisms of Writing, Reading, Recitation, Public Recitation, Conversation, Attention, Study, Difficult Recollection, and Greatest Effort. Such classification, especially in the last five groups mentioned, is obviously more or less arbitrary, but such lines of cleavage seemed to exist in the reports.

Without entering into all the details of Table II, certain general conclusions seemed justified by it.

1. The automatisms tend to vary with the nature of the activity in question. Contraction of certain muscles tends to predominate in writing, while others are most frequent in recitation, etc. In writing, lips and tongue furnish 46% of all the automatisms; in reading, body, head, hands and fingers comprise more than half the whole number; in recitation, feet, fingers, and body lead; in study, fingers, eyes, hands and jaws are most prominent; and so on. This variation is partly due to the manner of accomplishing the task in hand. There will be few automatisms of those muscles directly involved in a given task. Thus in writing, the hand shows few automatisms; in reading, the mouth, lips, tongue and eyes, very few. Another factor in differentiating the automatisms is posture. Those activities which involve standing would show, if everything else were equal, a slight difference in distribution of automatisms from those in which a sitting posture is taken. Swaying of body seldom appears when the subject is sitting, while of course standing on one foot or on the sides of feet, and the like, must depend on a standing position of the body. Again, when those parts which in the general table show greatest frequency of automatisms are pressed into actual performance of work—as the fingers in writing and vocal organs in reading,—the number of automatisms is not thereby apparently diminished. The wave of diffusion simply floods into the most susceptible of the paths remaining free.

A further point, of some significance, remains to be noted. The average number of automatisms per hundred persons appears to increase slightly with intensity of the effort. We exclude reading and writing data, which were collected under different circumstances, and are thus not strictly comparable with the other categories. Recitation, public recitation and conversation show an average of 120 automatisms per hundred persons. Attention, study, difficult recollection and greatest effort yield 136. The numbers dealt with are too

small to give very high value to the averages, but the result raises the important question: Does increase of effort increase the number of automatisms?

Observations in Boston Normal Training School.

It seemed desirable to attempt a more exact determination of the automatisms of young children; the following tests were therefore made in the kindergarten and primary grades of the Boston Normal Training School.[1]

The first series of observations was conducted in the kindergarten. On paper ruled so as to furnish alternate groups of lines, 4 mm. apart and 2.8 cm. respectively, the children were set to drawing lines, zig-zag or vertical, using top and bottom lines as boundaries. They were first to draw large lines for a certain time, then after a short period of rest, small lines for about the same length of time. The order of large and small movements was of course varied, small coming first about as often as large.

The children were arranged in successive groups of six or eight, and those of about the same age were placed in the same group. They were seated at the kindergarten benches, ample room being given, and were asked to "make soldiers" (straight lines), etc. They were urged to do the best work possible. The first group consisted of eight children, four girls and four boys, aged as follows: four girls, six years; two boys, six years; two boys, five years. They were allowed in the first instance to work at the large movements for about fifteen minutes, the time being lengthened in order to see what were the effects of fatigue. After a rest of about five minutes, the small movements were made for about ten minutes. This group showed from the first the most marked automatisms of any of the children tested. The second group (six children—four girls, two boys; girls three and one-half years, boys four) worked at large movements for ten minutes; then, after the usual period of rest, they made small movements for ten minutes. The number of automatisms was much less than in the preceding group. This may be partly due, however, to the fact that these younger children put forth less effort. The intermittence of their work tends to corroborate this view. The third group (eight children–four girls, four boys; girls five years; two boys five; one boy four

[1]For the opportunity of making these tests the writer is indebted to the courtesy of the Boston School Board. The facility of taking them was greatly increased by the kindness of Miss Aborn, in charge of the kindergarten.

and one-half years, the other four years) executed small movements for ten minutes, and then took large movements for the same length of time. The fourth group (seven children—four girls, three boys; three girls five years, one girl four; two boys four, one five years) executed large movements ten minutes, and followed with small movements for same length of time. In the primary grade the same general conditions were observed as above, but the time was lengthened and a large number of pupils participated. Ages of pupils six to seven years. The automatisms were strikingly less energetic and less frequent than in the kindergarten, many of the pupils showing no marked automatisms of any description.

The following is a summary of the observations made:

FIRST SET.

A. Large movements, fifteen min. M.[1] Left foot on side, lips pressed and moved slightly. M. Left foot on right one and twisting of left foot. Right foot on side. Lips pressed and moved with pencil. F. Head down, lower lip to one side, tongue slightly protruded or in one cheek. F. Left foot on right, lower lip moved slightly, knees moved. M. Right foot on left, shifting of feet. F. Head down, lips protrude, mouth moves with pencil. M. Right foot on left, left foot on side. F. Mouth open, head moved.

B. Small movements, seven min. M. Right foot on side. M. Lips move. F. Tongue moved in cheek. F. Legs crossed, lips moved slightly. M. Head on left side, later on left arm. M. Left foot on side, right foot on left, bent over his work, lips pursed. F. Right foot on left, tapping with right toe.

SECOND SET.

A. Large movements, ten min. F. Mouth open, tongue in cheek. M. Tongue out. F. Head down, lips strongly pursed, changed style and position often; pencil in fist, head on left arm. M. Tongue in cheek. F. Lips protruding. M. Scowl.

B. Small movements, ten min. F. Feet back and on sides. Head moved, lips pursed, then ajar, or twitching slightly. M. Left foot on right, lips open, or twitching slightly with movements of pencil. Tongue out. F. Right foot on left. F. Used both hands, then held pencil in fist. Head moved up and down with stroke of pencil. M. Left foot on right. Tongue in left cheek, then moved to other cheek. M. Lips set. F. Right foot on left, lips set. M. Frown, lips set, mouth moved slightly, left foot on right.

THIRD SET.

A. Large movements, ten min. F. Head down, almost to paper, tongue out, left foot on right. F. Mouth twitched slightly. M. Lips set, compressed more tightly in a rhythmical manner. Changed hands. F. Head down, left foot on right. F. Lips pursed, chin puckered, head on left side; theatrical, self-conscious. M. Tongue out, left foot on right. M. Frown, head close to paper, left foot on right.

[1] F. and M. are abbreviations for "female" and "male" respectively.

B. Small movements, ten min. F. Lips pressed, move with pencil, head lower than above, shook his hand in imitation of the third boy. F. Head down, lips move while pressed. Later shook her hand, seemed tired, and lips moved more. At close of time stretched. M. Tired, shook his hand and said he was tired; head lower. F. Head lower, left foot still on right at times. F. Same as above, except somewhat more marked; head lower. M. Tongue out, position about same as in former test. M. Frowned more strongly, head lower, left foot on right; stretched at close.

FOURTH SET.

A. Large movements, ten min. M. Left foot on right, lips pursed, mouth open and moved slightly. M. Tongue partly out, lips and tongue moved slightly. F. Writing with crossed hands, left-handed. Right foot on left. F. Right foot on left.

B. Small movements, ten minutes. M. Moved mouth slightly. M. Best worker, moved mouth slightly. F. Upper lip drawn in, tongue out little way. F. Changed hands toward end; talkative. F. Changed to left hand.

PRIMARY SET.

A. Large movements. M. 6. Head on left arm, lips set, but moved slightly. Head rotates. M. Head very low. F. 6. Head very low. F. Lips pressed and moved. F. 6. Head low, lips pressed. Head on side, tongue slightly protruded. Three F.'s with right foot on left.

B. Small movements. M. 6. Lips move more than when making large strokes; head lower and on one side. F. 6. Head at first inclined backward, then lower, right foot on left. F. 6. Tongue out slightly; body swayed to and fro.

The following general statements seem warranted by the above observations :—

1. The automatisms increase in number and intensity with age in the kindergarten groups, the class containing those of ages three and one-half to four years showing fewest and feeblest. The pupils in the primary grade, however, showed a great falling off in frequency and intensity of automatisms. This latter result is to be expected, inasmuch as the task was relatively easy for children of six or seven years. But the increase of automatisms in kindergarten with age is difficult to understand. Of course the number of cases observed is too small for statistical treatment, but the differences apparently due to age were certainly striking in the cases observed, and suggest the need of more extended observation and experiment. The youngest children seemed little capable of any considerable sustained effort, and in this fact may lie, as has been suggested, the explanation of the small number of their automatisms. Their automatisms were chiefly those of posture.

2. The automatisms were more pronounced in the making of small movements. In many cases the head was brought lower, the body assumed a more collapsed position, the lips

were either pressed more tightly or moved more perceptibly, and other movements were intensified. This suggests the very much greater difficulty of fine work for the child.

3. A majority of the pupils showed marked symptoms of fatigue before the close of the ten minute periods of work. Some shook the hand that held the pencil, others changed the pencil to the other hand. Holding the pencil in the fist, sighing, stretching, shifting positions of body, and frequent intermittences in the work were also noted in some cases; several also said they were tired. In nearly every case the automatisms showed a somewhat rapid increase toward the end of the work period. The surprisingly short time which a young child can work with sustained attention, suggests the need of more scientific determination of the proper period of effort than has yet appeared. The very great fatigue produced by the small movements of hand and fingers, emphasizes what has already been noticed by others, namely, the danger of requiring fine and precise work from young children. *Automatisms are thus a sign of the difficulty of tasks*, and the more intense automatisms exhibited by the children simply show that the given task demanded a degree of skill which they were not yet prepared to acquire. Further tests also in the lower grades of the elementary school might aid in determining at what age writing and other school subjects should be introduced.

Attention may be called in passing to the very great frequency of automatisms of posture. So many placed the feet on the sides, or the side of one foot on the other leg, or assumed collapsed positions of body while at work, that one can hardly escape the suggestion that here we may have that reversion to fœtal posture, noted by Preyer and others as very frequent in children much younger. This point will be further considered below.

Effect of Fatigue.

In answer to the question, "Does fatigue increase or diminish these automatisms?" the replies were not sufficient in number to be decisive. Thirty answered the question. Of these, twenty-three thought that fatigue always, or at least generally, increases the number or prominence of these movements and postures; four thought they diminished with fatigue, and three answered as follows: F., 21: "When fatigued, do not press teeth so tightly, but either rock or tap foot, or drum with fingers." F., 22: "Nervous fatigue increases movements, otherwise fatigue diminishes movements." F., 18: "Have seen intellectual fatigue increase

wriggling." Although in the state of exhaustion there is certainly a loss of muscular tone and a general inability to put forth more than a minimum of effort, it seems probable that in lesser degrees of fatigue there is an increasing restlessness and a distinct rise in the number of the common automatisms as the individual continues at his task. Galton[1] writes, "Restlessness appears to be the commonest sign of partial fatigue." The store of energy is waning and every resource of the mechanism of attention is taxed to call out the whole store of power. The rapid increase in the feeling of effort as fatigue comes on, must in part be due to the increased tension of the muscles in this attempt to arouse all the energy possible. In general, fatigue tends to affect the higher centres first. Inhibition is thus decreased and the motor centres tend at the least stimulation to break out in more or less random movements. Galton mentions the following movements observed during fatigue: sudden muscular movements, grimaces, frowning or compression of lips, twitching of fingers, face, twitching and blinking of eyes, fluttering of eyelids, tendency to nervous laughter or movements. The general unsteadiness of muscular coördination is shown by bad and shaky handwriting.[2]

On the whole, therefore, in view of the diminution of the store of energy and the decline of inhibition, we may expect, in many cases at least, an increase in the number, but a gradual diminution in the intensity of the automatisms when effort is continued during fatigue.

Conclusions. The returns would seem to justify the following general statements:

1. Automatisms of accessory muscles are most frequent. Muscles of the face and head and the fingers and feet furnish a large majority of the total number.
2. Automatisms of the fundamental muscles (body, legs, arms) disappear rapidly with age.
3. In general, automatisms decline in frequency with age. But an increase with age is marked in the frequency of certain specialized contractions, and indicates the gradual settling of expression in the face. The movements of eye, brow and jaw show greatest increase with age.
4. Automatisms show greater individual variation than do the specialized contractions which they accompany.
5. Sex has little influence upon the relative frequency of automatisms.
6. Automatisms vary with the nature of the work and the general posture of the body.

[1] "Mental Fatigue," *Journal Anthropolog. Inst.*, XVIII, 2.
[2] Galton, *ibid.*

7. Automatisms tend to increase in number with fatigue.
8. They increase in intensity and often in number, with increase in effort.

General Considerations.

The present section is devoted to an attempt to classify and interpret the motor phenomena of effort. As a brief résumé of the data to be explained, the following synoptic table of the expressions of thought, taken from Mantegazza's *Physionomie*,[1] is transcribed: —

"1. *Contractions and relaxations of the muscles of the face.* Contraction of brow muscles, immobility of the eyes, erratic contractions of all the ocular muscles, immobility of all the muscles of the face, exaggerated opening of the eyes, closing or semi-closing of eyes, depression of lower jaw, extreme elevation of one brow, partial or total convulsions of the facial muscles.

"2. *Contractions of the trunk.* Immobility of the whole trunk, catalepsy, partial or total convulsions.

"3. *Sympathetic movements and the more frequent rhythms of members.* Scratching of head, forehead or nose, feeling or touching the head, tapping the forehead or taking the head in one or both hands, caressing cheek or chin, rubbing eyes vigorously, shaking the head, making rhythmical gestures with arms or hands, making rhythmical noise with feet or hands, moving legs incessantly and rhythmically, closing the ears with the two hands."

These movements and attitudes seem to belong to three types:

1. Those which represent specialized contractions; as adjustment of sense organs and the other concomitant changes in the so-called "muscles of expression." These are chiefly facial muscles.

2. Those movements and attitudes which seem to be the result of the general excitement of the nervous system; as swaying of body, tapping with fingers or feet, and the like.

3. Certain postures, which may be the joint result of the withdrawal of the supervision of consciousness, and of the contractions which result from the general nervous excitement.

It is assumed that all mental effort is voluntary attention. This form of attention, we are told, is derived from spontaneous or natural attention, and is in the main a product of civilization, having developed out of the necessity for work.

[1] Mantegazza, 2d edition. Paris, 1889, p. 171.

A brief discussion of some of its phases, and especially of its mechanism, will reveal the basis of the foregoing classification of effort expressions.

In the first place a comparatively low intensity of general awareness is the condition of consciousness in repose. To replace this with a high degree of special alertness, involves the repression of irrelevant sensations and ideas and the emphasis of the relevant ones. So difficult is the attainment of this state of attention that "it drains for its own use, at least in the proportion possible, the entire cerebral activity."[1] Not only do the vaso-motor changes, producing local hyperæmia of the brain, show this concentration of effort, but also the movements and changed attitudes of the body indicate such focalization. In that original and typical form, known as spontaneous sensorial attention, as when a child is captivated by a brightly colored object, the whole body converges toward the object, all the sense organs seem to have a focus at the same place and all motion is arrested. But the investigations in physiognomy show that these muscular contractions are not of equal value, either in relative energy or for the recognition, by an observer, of the nature of the conscious state. Just as consciousness is focalized, so the motor accompaniment tends to have its centre in the muscles of expression of the face and head. Mantegazza writes: "Intellectual expression groups itself always about the head, which is the seat of thought." Again, "If it is necessary to limit to the least space the field of the expression of thought, I include it in the space of some square centimetres which extends below the eyebrows and between them."[2] Piderit accounts for the face as the chief seat of expression partly on the ground that in the face the muscles lie stretched close upon the bones, so that the smallest trembling of a muscle is perceptible to the eye. Furthermore, the roots of the facial nerve arise in the brain in the immediate neighborhood of the "soul's organ," thus rendering spread of nerve currents to this tract especially easy. Lastly, the muscles of the face support the sense organs.[3] Chas. Bell held that the facial muscles assume their important rôle in expression because they are accessory to the muscles of respiration. Both facial and respiratory muscles are controlled by nerves whose nuclei are contiguous, and both assist in communication through their relation to vocal expression. It is here, therefore, that we should expect to

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[1] Cf. "Psychology of Attention," Ribot. Chicago, 1894, page 4.
[2] Mantegazza, *op. cit.*, p. 173.
[3] Piderit, "Mimik und Physiognomik," p. 33, 2d ed. Detmold, 1886.

find the most characteristic motor accompaniments of mental effort.[1]

1. *Specialized Contractions.* As the phenomena of "normal expression" are to be considered here only in so far as they contribute to our knowledge of "common automatism," nothing more than a very general sketch of the outcome of the studies in this field is attempted. For more detailed account of the principles of expression, the reader is referred to the works of Darwin, Duchenne, Piderit, Mantegazza and others. One of the pioneers in the scientific study of "specialized contractions" was Duchenne, who considered that he had proved, by electrical stimulation of separate muscles, that a single muscle might be sufficient to the expression of thought or emotion. He called the *occipito-frontalis* (the muscle which lifts the brows) the muscle of attention, the *orbicularis superior* of the eye-lids the muscle of reflection. Darwin, whose great work[2] still remains perhaps the most important in this field, attempted to explain the origin of the association of certain expressions with certain mental or emotional states. Wundt, Piderit, Mantegazza and others have also attacked the problem of the origin of these expressions. Without discussing in detail the various principles invoked by these authors, suffice it to say that all agree that no muscles exist, as Duchenne and other earlier writers thought, simply for the purpose of expression. All now make large use of the idea that expressive movements are more or less weakened repetitions of movements that were once of utility, and becoming closely associated with certain mental states, tend to reappear when these states reappear. Darwin held that the raising of eyebrows in outward attention aids in opening the eyes for better vision. Opening of the mouth aids in intense listening and in the rapid catching of the breath which precedes muscular effort. This opening of the mouth tends to reappear in states of astonishment. The contraction of the muscles around the eyes, of which the primitive use, according to Darwin and Donders, is to protect these organs from being too much gorged with blood during the screaming fits of infancy, survives in adult life in the frown, which comes when anything displeasing presents itself either to thought or action. Mere effort of attention or reflection is displeasing, and thus the *corrugator supercilii* has been called by Duchenne the muscle of thought. The frown, says Darwin, is further developed by need of primitive man for best vision in search of prey or dis-

[1] "Anatomy of Expression," Charles Bell.
[2] "Expression of the Emotions."

tant enemies. Being bareheaded, the brows were contracted to shut out excess of light. Gratiolet calls attention to other useful movements that become associated with continual use of eyes, as closing of eyes and turning away of face when an unpleasant proposition is made,—a survival from disliking to see something unwelcome. In difficult recollection the eyes wander about as if trying to see that which is desired. Wundt, by his principle of reacting similarly to similar feelings, explains many of our expressions by reference to their analogy to "taste," etc. Many experiences are "bitter" or "sweet," and our behavior is the same that it would be if we actually experienced such tastes. Piderit also emphasizes the frequency of our responses to the fundamental senses. Preyer has explained the opening of the mouth in attention, and the protrusion of the lips, by reference to the fact that the first attention of all animals is directed to the search for food. "All examination of and all testing of food is attended by a predominant activity of the mouth and its adjuncts. Especially in sucking, which first awakens the attention of the newly-born, is the mouth protruded."[1] This often remains for years, and appears when attention is strained, especially in such activities as writing, drawing, and the like. Wundt and Piderit have also called attention to the fact that we tend to act as if the object of our emotion or thought were present to us. By intense attention the gaze is fixed on the object, also when the object of our attentive thought is not present, the gaze tends to become fixed. If we frown, we feel something in the eyes that reminds us indefinitely of a blinding light. Mantegazza regards the frown as due merely to sympathy through the contiguity of the nerve-centres of eye and brow.

Many writers have noted the firm closing of the lips during certain activities, and Darwin thought it was perhaps to prevent the respiratory movements interfering with the fine adjustments necessary, for instance, in threading a needle. Gratiolet considered it, since it appeared in effort, as a part of the action of deep respiration, which has for its purpose the retarding of circulation. Mantegazza also considers it as incidental to the deep inspirations which precede effort. Finally, a principle of antithesis is brought forward by Darwin, to account for a few phenomena of expression, as shrugging of shoulders. This principle is essentially that if a certain stimulus prompts a certain set of movements, then a contrary stimulus will prompt the contrary movements.

[1] "The Senses and the Will," p. 303.

Although many of these suggestions seem plausible, the main impression produced by the literature of the subject is that we have only begun to realize the scope of the phenomena involved, and we can only hope for adequate treatment of "expression" when heredity in all its length and depth has been explored. A further conclusion is that the line between so-called movements of normal expression and the common automatisms is a vanishing one, and perhaps in the light of a larger survey of facts it may be shifted so as to include many, if not all, of the latter class.

2. *The Automatisms of the Second Group* are very numerous, and so great are the difficulties of explanation that only the most tentative classification is offered. In general these phenomena are products of the general nervous excitement which appears in mental effort. The following divisions may be made: —

A. Those movements which are simply the result of "diffusion." They include:

a. Movements due to defective inhibition; as twitching of eyes and fingers, squinting, and most cases of "nervous" movements.

b. Movements due to sympathy and imitation, as moving of jaws in unison with scissors, moving of head, tongue and lips with the rhythm of movements of the pen.

B. Those movements, whatever their origin, which help to maintain a sufficient excitement of the brain.

C. Those which serve as a "short-circuit" for such slight nerve currents as otherwise might reach the cortex and dissipate the concentration of consciousness present in mental effort.

These classes overlap to a very great extent, and the above classification is rather a statement of different points of view from which many of the same phenomena may be considered.

There can be no doubt that the effort of voluntary attention increases the activity of the central nervous system. The struggle for the focalization of consciousness, with the concomitant contractions of the muscles of the face and head, must unlock much energy hitherto latent. Again to quote Ribot: "A man worn out by a long walk, by great mental exertion, or who succumbs to sleep at the end of the day's task; a person recovering from a severe illness; — in a word, all debilitated individuals are incapable of attention, because like every other form of work it requires a reserve capital that may be expended. In passing from the state of distraction to the state of attention, there is accordingly a transformation of potential into kinetic energy." How much of

this increased activity is due to the reserve store already in the nerve cells, and how much is produced by the increased charging of the cells by the immediate augmentation of the flow of blood to the encephalon, cannot be determined. Whether the initial stimulus to this arousal of the brain comes from within, in the form of a spontaneous idea, or from without in the form of a sensation, the impressions which flood back from the muscles of expression (including the visceral and other involuntary muscles) may have an important function in further increasing the cerebral activity. The state of attention can be preserved, then, only in proportion as the supply of excitation is adequate. Thus the beating of the head, rubbing of the face, and the like, which by stimulating parts near the brain would be especially efficacious in keeping up the cerebral activity.

A further evidence of the excitement of the central nervous system is furnished by the general tendency to immobility of the body. This quiescence is manifestly not due to a relaxation, but to a contraction of opposing muscles, and consequently represents a considerable expenditure of energy. This excitement, if not under control, overflows and dissipates itself in more or less random movements. At best, voluntary attention is rarely sustained for any great length of time, and seldom is the bodily convergence complete. If the act of voluntarily giving one's-self to the consideration of a task is to be in any degree successful, there must be a considerable intensity of acquired interest and a high development of inhibitory power. The development of this control of mind and body is a slow and toilsome growth, and a brief discussion of its unfolding is of importance for our purpose.

The question of control is, in part at least, the problem of inhibition. The central nervous system has a regulated tone. It is a hierarchy of centres. Each centre tends to constrain and direct the movements of those below, and is in turn more or less controlled by those above. To mention a single illustration,—it is a well-known fact that the reflexes of a brainless frog are greater than those of the normal animal. All authorities agree that the highest control, expressed in such activities as are designated by the terms deliberation, choice, and will, are bound up with the integrity of the higher cerebral centres. Any defect of these centres results in disturbance of the normal activities of the organism, and may lead to grave motor derangement. Pathology presents a vast array of such defects. The prodigal activity of mania, the twitchings and automatisms of late stages of certain febrile disorders, many abnormal postures, and facial expressions of

victims of nervous disease, illustrate this deficiency of controlling power.[1]

In the normal infant, moreover, the higher cortical centres are as yet only slightly developed, and in consequence inhibition lags behind. The lower nerve centres, well nourished and inadequately connected with the higher centres, are discharging constantly into all the muscles, producing that restlessness which has been denominated the very essence of childhood.

The order of development of the nerve centres, then, is from the lower to the higher; from those which mediate coarse adjustments to those which subserve the finer and higher activities. Thus the centres for the body, those of trunk, neck, arms and legs, the so-called fundamental muscles, ripen much earlier than those of the vocal organs, fingers, toes, and the like, which are denominated the accessory muscles or organs. We find here, therefore, an explanation of the greater frequency of the common automatisms of the accessory organs. They elude control longer, and in the lives of most of us never yield implicit obedience.

Chorea, a typical disease of the growth period, shows many of the phenomena of infirmity of control writ large. It has been defined by Sturges as an "exaggerated fidgetiness." Its favorite age is from six to fourteen years. The parts of the body become subject to chorea in the order of the use as intelligent instruments. Untaught muscles and such as have never been employed as the agents of intelligence never suffer chorea. Arms suffer more than legs, fingers more than arms, and the face (among older children) most of all. "Chorea indicates the withdrawal or infirmity of controlling power."[2] Says Clouston, "I think it may be taken as a rule, with few exceptions, that the tissues, the organs and the functions which are of slow development are those which hereditary evil tendencies are most apt to influence."[3] The motor processes are not fully developed until the close of the period of adolescence. This tardiness of growth affords most favorable conditions for the development of inherited motor defect or the fixing of acquired peculiarities of posture and movement. The stress of environment is often too great for these unripe and unstable centres. The pressure of modern life, with its demands for a multitude of fine and precise ad-

[1] Cf. Bancroft, "Automatic Muscular Movements of Insane." Am. J. Psych., III, 4.

[2] Cf. Sturges, "Chorea," London, 1881; Sachs, "Nervous Diseases of Children," London, 1895; Donkin, "Diseases of Childhood," London, 1893; Clouston, "Neuroses of Development," London, 1891.

[3] Clouston, "Neuroses of Development," p. 7.

justments, is severest of all upon the accessory muscles, just those whose centres develop so late, and are consequently, in the child, least under control. Conventionality and social custom tend to repress the expression of feeling or thought. This operates to check the nervous exaltation and the intense expression of the young. The school demands bodily stillness, which requires a degree of self-control found only in the best trained adults. Because these conditions interfere more or less with the normal growth of the child, they tend to render inhibition permanently defective.

The natural imitativeness of childhood also contributes to the acquisition of new, or the confirming of old evil motor tendencies. The child sees a movement which he consciously or unconsciously repeats. The habit is quickly formed, and if it supplies an outlet for his energy, soon becomes unconscious, and thus so difficult of repression that it may survive for life.

These three factors, therefore—the enormous activity of the child, the inability to completely control his movements, and the proneness to imitation,—furnish the rich soil out of which spring many of the common automatisms.

The development of inhibition is clearly seen in the gradual disappearance of automatisms of the fundamental muscles, and later of the movements of the accessory muscles which might distract attention. It seems highly probable that most of the automatisms of a normal individual that survive, do so because they actually serve attention in ways soon to be considered. In the children, the automatisms of the head (neck muscles), body, legs and arms constitute 9.7 % of the total number reported, while the same movements and postures reported of adolescents are only 4.4 % of the total, showing a decrease with age of more than one-half. The returns do not show clearly the relative number of extravagant movements, such as indicate incipient nervous disorder.

A.—Automatisms due to Sympathy and Imitation. A child learning to write moves not only the writing hand, but also head, lips, tongue, and, in one case reported, the corresponding forefinger of the other hand. This illustrates the general fact that in acquiring any skill, the first movements employ more muscles than are later needed. Schneider's [1] simile states the case, "Imagine the nervous system to represent a drainage system, inclining on the whole toward certain muscles, but the escape thither somewhat clogged. The streams of water will, on the whole, tend most to fill the drains that go towards these muscles and to wash out the escapes. In

[1] Quoted from James' "Psychology," I, page 113.

case of a sudden flushing, however, the whole system of channels will fill itself and the water overflow everywhere before it escapes." In the child learning any difficult thing, there is this intense flood of energy and no sufficiently definite control of the motor centres involved. The overflow follows the path of least resistance. Hence the centres most affected will be (everything else equal) those most contiguous to the centres from which the diffusion spreads; secondly, those which belong to muscles most frequently employed (usually the smaller muscles); and lastly, those most frequently associated with the activity in question. Those parts of the body which comply with all three of the above conditions, manifestly will exhibit the greatest tendency to movement. Lips and tongue have centres not remote from that of the hand; they are among the most frequently employed muscles, and finally there is evidence, from the facts of aphasia, that in most cases the motor speech centre is probably innervated whenever writing is performed. The movements of the corresponding finger of the other hand may be due to contiguity of the centres in the cord, and to close association of corresponding centres in the cortex. The head movements, intermediated by muscles of the neck, may be partly due also to contiguity. The idea of a rotary movement not only leads to such a movement of the hand, but also of the other mobile parts. Suggestion through the eye of the movement of the writing hand or of the pencil, may reinforce the tendency of the "automatic" movements to assume the same general form.

B.—Excitatory Automatisms. Certain automatisms appear in mental effort, even among the best trained thinkers. An eminent university teacher plays with watch-chain as he becomes most deeply absorbed; a prominent United States senator plays with keys; Lord Derby is said to have always chewed something when making the greatest mental effort, and so the list might be lengthened indefinitely. These automatisms can hardly be explained on the ground of defective inhibition. They are accessory to the mechanism of attention. In order that mental activity may be brought to its maximum, and kept there during a period of work, the circulation of the brain must be rendered adequate, and the latent energy of the nerve cells must be aroused. To aid in accomplishing this, many movements have appeared in the race and in the individual. Their sole *raison d'être* seems to be that they facilitate the work of the brain. Any sort of movement or stimulation may serve, provided it be not so great as to distract the attention. Prominent among the automatisms of the present group are those which are concerned with the stimu-

lation of some part of the face or head. This region is supplied by the tri-facial nerve, and excitation of this nerve seems specially efficacious in arousing the brain. Chewing has been shown to increase the carotid circulation. The use of tobacco, chewing gum, sweets, has been resorted to during periods of great effort of thought. These stimulate the facial nerve. Also the scratching of the head, or stroking of beard or moustache, pressing of forehead, rubbing of eyes, pulling at parts of face, striking the nose, illustrate the value of the stimulation of this nerve. Dr. Lauder Brunton also suggests that there may have been a similar reason for use of snuff. "The general titillation of the mucous membrane of the nose, probably serves to stimulate the cerebral circulation, and the increased arterial tension due to the effects of sneezing, so increases the cerebral nutrition that difficulties seem at once to disappear, and obscurities of mental vision are so rapidly removed that snuff is said in popular language to "clear the head." The above quotation is given for what it is worth, but it does tend to emphasize the very great importance of these stimulations of parts near the brain. Mantegazza distinguishes these movements from those in which the head and scalp are given blows which seem to increase cerebral activity by jarring the brain. If this explanation is true, he thinks it explains why some persons cannot think at their best except when in a carriage, on horseback, or in a boat. Besides the movements which stimulate the face and head, those of the fingers and feet seem also frequent and important. The "drumming" habits of many when in perplexity or deep thought, the need of walking in other cases, probably belong to this category. Slow rhythmical stroking of the head has an opposite effect, soothing rather than arousing the brain. This seems due to the fact that the organism is "set" for certain rhythmical stimulations, the diffusion of the regular impulses being slow enough to proceed without discharging much stored energy.

All active movements therefore, whether of face, hands, legs or feet, tend to increase the central excitement, and this in turn is the necessary condition of great intensity of attention. Movements too excessive, by distracting attention defeat their own purpose, and therefore tend to fall away in all individuals, excepting of course those in whom control is to a great extent deficient. And with these, any high development of the power of voluntary attention is impossible.

C.—Short Circuit Automatisms. Prof. James[1] has advanced the view that certain automatisms are protective of the state

[1] Cf. James' "Psychology," Vol. I, (pp. 457, 458).

of extreme attention. The activity of these movements, according to him, "drains away nerve currents, which if pent up in the thought centres would very likely make the confusion there more confounded. But may it not also be a means of drafting off all the irrelevant sensations of the moment, and so keeping attention more exclusively concentrated upon its inner task?" That automatisms may often play this rôle seems highly probable. But some automatisms appear before there is any considerable degree of attention to be distracted, and many of these or others continue more or less intermittently throughout the whole effort period. At the beginning they certainly seem excitatory. It would appear probable that these two functions, the excitatory and the protective, supplement each other. Prof. G. E. Müller[1] in discussing the well-known fact that the cessation of an unfelt stimulus may be felt, suggests "that impressions which come to us when the thought centres are preoccupied with other matters may thereby be blocked or inhibited from invading these centres, and may then overflow into lower paths of discharge." Now the automatisms at first aid in increasing the cerebral excitation. Under this favorable condition, or concomitantly with it, the state of attention waxes in intensity. When it reaches its height the blocking or inhibiting process may act to shut out the excitatory currents for the moment. Then the nerve paths of the automatisms become the channel for the drafting off of all currents which are excluded from the brain during attention, because "incidental stimuli tend to discharge through paths that are already discharging rather than through others."[2] Hence the movements tend to be kept up, but now serve a different purpose. Furthermore, attention fluctuates. With waning energy of brain, the wave of intensity of attention begins to fall and thus releases to some degree the inhibitions upon these currents flooding in from the contracting muscles, and thus these impulses again reach the brain, and again increase the excitement; only to be shut out again when attention reaches its maximum—and so on until the store of energy is exhausted or the task completed.

If this conception be true, it serves to explain certain important characteristics of automatisms. It is the experience of the writer, and also of others who have been questioned, that the movements preliminary to effort are often different from those which appear when attention is at its best. Moreover, the movements during effort tend to vary both in form

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[1] James, *ibid.*
[2] James, *ibid.*

and intensity. When sitting down to a task the arms may be stretched, or parts of the face and head rubbed, scratched or pulled with considerable energy. Or even sometimes the necessity of walking about the room seems imperative in order that worker may "pull himself together." The stretching and straining which often immediately precede the word "go" in an athletic contest are of the same violent sort. These represent the excitatory phase of the automatisms, and when the attention begins to weaken they often reappear again. On the other hand, when the work is under way and concentration seems at its best, the movements tend to become more intermittent and much less violent, and may appear simply as slight twitchings of parts of face, or drumming with fingers, and the like; which are frequently mere fractions of the former total movement. This would be expected, if the automatisms were at the time serving as short circuits for the more or less incidental currents which must be drafted off. That voluntary attention is a late product, and an incomplete copy of spontaneous attention, is shown by the very fact that it proceeds by such expensive devices as these automatisms. We need not look farther for an explanation of the more rapid fatigue in voluntary attention as compared with spontaneous. Lastly, if further observation and experiment should confirm the view of automatisms above suggested, this point of attack may furnish materials for a revision of the theory of attention.

3. *Automatisms of Posture.* Observation of children writing and at other tasks reveals a series of postures so significant as to demand special consideration. Forward bending of the body, with head very much too low, and perhaps on one side, with feet on sides or the sole of one pressed against the lower part of the other leg, represents fairly the usual posture of children in writing. In "recitation" standing on sides of feet is also very prominent. The whole attitude of the child here, as to a certain extent, also in any mental occupation which strongly claims the attention, is so suggestive of reversion that one can hardly escape the conclusion that we have here a return to fœtal posture, and even perhaps a recrudescence of the bodily attitude of man's more remote ancestors. The forward convergence of the body may, of course, be in part due to desire to bring the eyes nearer the object to which attention is given. Dr. Lauder Brunton[1] claims, furthermore, that forward inclination increases cerebral circulation and thus facilitates mental activity. This may have become automatic in the race, but after making allowance for such factors, there

[1] "On Posture and its Indications," *Lancet*, July, '92.

remains a third alternative, namely, that the general collapse of body is "atavistic." Every one knows how difficult is the preservation of the upright position of the body. It requires even in most adults, some supervision more or less conscious, and represents a great daily expenditure of energy. The general drooping forward of the body in fatigue shows how considerable has been the innervation of the muscles in maintaining erect posture. Preyer says that the ability to maintain a sitting posture appears comparatively late, the time varying with different children from the fourth to the eighth month.[1] We may assume, then, that it represents a difficult acquirement, and early in life demands a considerable conscious direction. There is further evidence that control never becomes entirely automatic even with such facile organs as the eyes. Donders holds that in reverie the eyes do not have axes parallel, but really slightly divergent; he also remarks that when one eye becomes blind it always, sooner or later, deviates outward. Le Conte[2] finds that the axes diverge "when we lose control over the ocular muscles, as in drowsiness, in drunkenness, in sleep, and in death." Such cases show clearly the need of control of the eye, in order that the organ may function properly. And if the eye muscles thus fall out of function when consciousness is at a minimum, as in falling asleep, or when the mind is completely absorbed, we can understand why other muscles released from restraint tend to do likewise. The "reductives," so to speak, that enable the centres of control to keep the body upright, are sensations of sight, and those that flood inward from the muscles involved. Now, when there is a low intensity of consciousness available for this function, as in sleep or in fatigue, or when consciousness is strongly focalized on something else, these cues are not appreciated, and in consequence the body and the limbs tend to relapse into those positions which, on the whole, are most habitual. From the standpoint of philogeny, the most habitual attitude must be the most primitive. That the muscles of these members are not relaxed, but contracted, as a result of the general excitement of effort, does not invalidate the explanation, inasmuch as the contractions would follow the same law of premature habit. It seems a generalization of wide applicability, that in proportion as the control of a part of the body declines, there is a tendency of those parts to lose the latest acquisitions and fall back as far as possible upon the primitive conditions.

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[1] "The Senses and the Will," p. 267.
[2] "Sight," Le Conte, p. 255.

The points of this general discussion are put forward merely as suggestions, or even as speculations. At the same time their value will not be lessened by explicit formulation:

1. Many automatisms represent processes for the production and maintenance of central nervous energy, as well as for the protection of the state of attention. They may therefore be considered as important features of the mechanism of voluntary attention.

2. Other automatisms are the result of defective control, and consequently represent serious leakages of energy.

3. Many of the postures suggest reversion to fœtal postures and also to primitive attitudes.

While the questionnaire replies upon which this study is based, were too few in number to yield quantitative results of great value, the high quality of the returns nevertheless justifies the belief that they develop the salient facts concerning the subject in hand. The method is richly suggestive, and defines many problems which can be approached later by wide, systematic observation and experiment. To illustrate: It seems possible to determine experimentally the order in which the different automatisms in a given case arise and decline; the influence of the degree of effort and of fatigue upon these muscular contractions; and the relative influence upon cerebral circulation of the various automatisms. Pedagogically a knowledge of these automatisms is of immediate practical importance. If our classification is correct, these phenomena must not be indiscriminately dealt with in the child. While some automatisms deserve summary repression, many, because they are the means of developing working power, should not, at least, be discouraged. If still others are results of too great deficiency of control, the demand is for the most careful hygienic, if not medical, treatment. Moreover, the excessive movements which accompany the performance of any difficult school task, may serve as an index for a determination of the age at which these requirements may be safely imposed upon the child. If, for instance, in learning to write, the automatisms do not tend to fall away rapidly with practice, then it may be assumed that the centres and muscles involved are not ripe for such a task, and that the strain of performing it is likely to produce, not skill, but nervous disorder.

The writer wishes to express his very great obligations to President Hall, who directed attention to the problem and who coöperated in the collection of data; also to Dr. E. C. Sanford for many helpful suggestions.

LIGHT INTENSITY AND DEPTH PERCEPTION.

By T. R. Robinson, B. A., Toronto.

In a former article the writer described some experiments in connection with the "paradoxical experiment" of Fechner, made in the psychological laboratory of the University of Toronto, with the purpose of investigating the relation of the light intensities of monocular and binocular vision. It was found that the relation could not be very definitely determined, not only because of the variability of the subjective conditions which largely affect it, but also because it depends in great measure upon the absolute light intensity of the object or objects observed. The results, however, suggested some further inquiries, which have been pursued by a method which the present article is an attempt to describe.

The "paradox" of Fechner consists in the fact that when one eye is partially obscured by a smoked glass or other means, the closing of that eye results in a *brightening* of the common visual field, or of an object in the common visual field; *i. e.*, a decrease of intensity of physical stimulus results in an increase of intensity of sensation.

Aubert, following Fechner, found that at a certain degree of obscuration of the second eye occurred the greatest darkening of the common visual field, and that the admission of less light to that eye had then the same effect as the admission of more light, viz., a brightening of the common visual field. This point of greatest darkening Aubert calls the "minimum point," and above and below it are "conjugate points," where the admission of a small or a large degree of light has the same effect upon the brightness of the total visual field.

My own experiments showed that the paradoxical phenomenon occurs only when most of the light is excluded from the second eye. If, on the other hand, comparatively little light is excluded, on the closing of that eye the whole visual field appears darker. Between these limits there is for every absolute intensity what may be called an "indifference point," or point of inefficiency, at which the light admitted to the

second eye has no effect upon the brightness of the common visual field, or of an object in the common visual field.

Dr. Kirschmann, in a comment upon the writer's experiments and their results, as published in a former number of the JOURNAL, offered two suggestions as furnishing a problem for further investigation: (1) That where the paradoxical phenomenon occurs, it is due to the fact that the physical energy which reaches the retina of the partially obscured eye is less than the energy required for combining the two impressions and localizing them in the third dimension. In that case, part of the energy communicated to the retina of the free eye may be subtracted to aid the other eye in producing the binocular combination ; then, on the closing of the other eye, this part of the energy would be set free and the result would be an increase of the light intensity. (2) That the " conjugate points " of Fechner and Aubert may be accounted for by the assumption that where one of the monocular intensities is very low, while the other is comparatively high, the binocular combination does not take place. Thus Aubert found the point of greatest darkening where, the light admitted to the undarkened eye being represented by 1000, 122 parts were admitted to the other eye. If this were the lowest point at which the stereoscopic effect is produced, then below it all the light admitted to the second eye would go to increase the light intensity, and, similarly, above it the additional light would have that effect.

Taking, then, these suggestions in connection with the results of previous investigations as a starting point, the experiments which this article describes had for their object to determine the least amount of light which must be admitted to the second eye to produce the stereoscopic effect, and to find whether or not that amount of light corresponds to the amount which is inefficient as regards the comparative light intensities of monocular and binocular vision. If the first of the above suggestions were correct, we should expect to find that the maximum of light which can be admitted to the partially obscured eye without increasing the total brightness, approximates to the minimum of light required in that eye to produce the stereoscopic effect. If the second suggestion were correct, we should expect that the stereoscopic effect would not appear below the " minimum point " of Fechner and Aubert, *i. e.*, where less than 0.122 of the full light was admitted to the second eye.

The apparatus used is shown in the accompanying plate (Fig. 1). Though simple in appearance when completed, and very easily manipulated, its construction required much care. It was manufactured especially for this research from

a design furnished chiefly by the director of the laboratory, Dr. Kirschmann, to whom also thanks are due for valuable suggestions and assistance throughout the investigation. In front are two stereoscopes, the inner lens of each of which may be closed by means of a small shutter. Behind these is an episkotister disc turned by an electric motor; this disc is graduated in 360° and arranged so as to vary the light admitted between the limits of 0° and 270°. The stereocopes are arranged before the episkotister in such a way that one eye looks at the object directly, the other through the revolving disc. Immediately behind the disc is placed a black velvet screen with two openings on each side, opposite the lenses of the stereoscopes. Behind this again at the focal distance of the stereoscopes, is a second black screen, on which are fixed the objects to be observed. The objects chiefly used were four small squares of white cardboard placed before each stereoscope, with right-lined figures drawn, as in Fig. 2, so that when combined they present the appearance of two pyramids, one above the other, the apex of the upper one projecting towards the observer, that of the lower one receding, and thus presenting the appearance of a hollow passage. By the use of *two* sets of objects and *two* stereoscopes, there were avoided possible errors which might arise (1) from a difference between the two eyes of the observer; (2) from a difference in the treatment of the two eyes throughout the experiments. The purpose of using two pyramids on each side was to afford an indubitable criterion of the binocular combination. This criterion consists in the small squares which form the summit of the pyramids being seen in the middle of the larger squares and vertically one above the other. Such a criterion is necessary, because as the light admitted to one eye is gradually decreased by means of the episkotister, the binocular combination does not at a certain point suddenly cease, but becomes gradually less and less complete, until at length it ceases to be perceptible. It was found necessary to use the simplest outline drawing possible, as photographs, etc., have, even when looked at with one eye, a certain depth effect, dependent, of course, on secondary factors of depth perception, which made discrimination more difficult.

The observer looks alternately through the right and left-hand stereoscopes, and after each double trial[1] readjusts the episkotister so as to admit more or fewer degrees of light, and continues thus till there are found (1) the lowest point

[1] This does not imply a perfectly conscious method, as the observer was unaware of the absolute intensity.

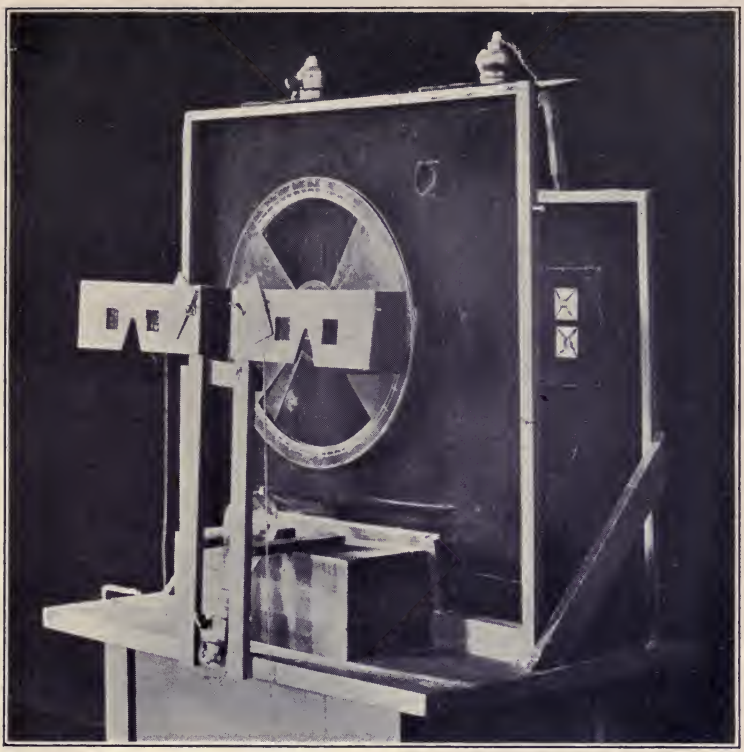


FIG. 1.

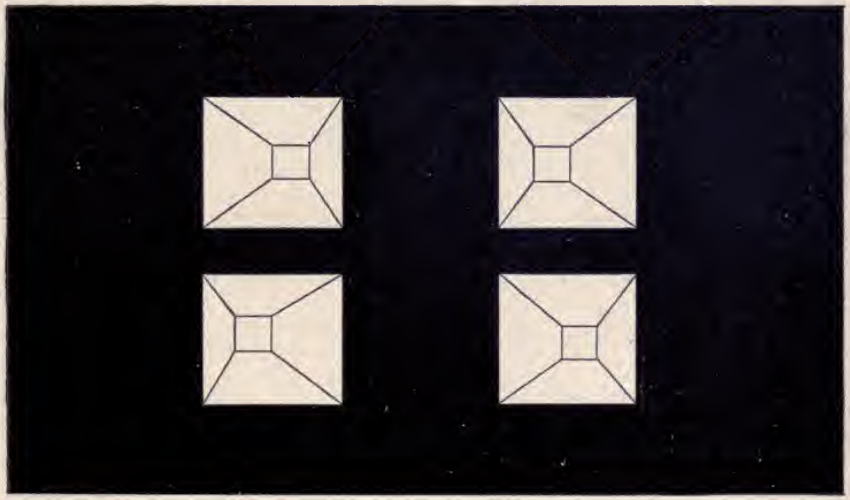


FIG. 2.

at which the objects continue to be completely combined, and (2) the point at which there is no longer any combination at all. The shutter is used to close one lens of the stereoscope so as to compare the monocular and binocular effects. The "indifference point" of light intensity is found, according to the method described fully in the former article, by first looking through the stereoscope at the objects and then excluding one eye by means of the shutter, and after each trialreadjusting the disc until a point is reached where no difference in brightness is observable, whether the object is regarded with one eye or both. The adjustment of the episkotister wasfacilitated by the use of the incandescent lamp, shown in the front of the figure, between the supports of the stereoscopes. This light was turned off during the trials, and when in use screened from the eyes of the observer. The screen used for this purpose, as well as the black velvet covering kept over the apparatus when in use, is not shown in the figure, in order that all parts of the apparatus might be more distinctly visible. Each set of objects was lighted by an electric lamp suspended between the screens, and the intensity was varied by using lamps of different candle power, or by placing sheets of tissue paper around the lamps. All the experiments were conducted in a dark room. Owing to the number of trials required, it was not possible to secure series of trials from many observers, but those obtained had the advantage of being made by persons accustomed to psychological experimenting, the observers, besides the investigator, being Mr. W. B. Lane, M. A., a fellow graduate student, who was conducting some researches in the laboratory; Dr. Kirschmann, and Mr. A. H. Abbott, B. A., assistant in the laboratory. The writer desires to express his indebtedness to the kindness of these gentlemen, especially Mr. Lane, who devoted much time to patient observation. The results of the trials are shown in the following tables.

TABLE I. OBSERVER R.

Description of light used.	Photometrically determined intensity of the light.	Minimum amount of light necessary for the second eye in order to obtain complete stereoscopic effect.			Amount of light for the second eye inefficient for the stereoscopic effect.			Amount of light for the second eye inefficient for the brightness of the combined visual field.		
		a. In degrees of the Episkotister.	b. In units of intensity.	c. Ratio of the intensity for the other eye.	a. In degrees of the Episkotister.	b. In units of intensity.	c. Ratio of the intensity for the other eye.	a. In degrees of the Episkotister.	b. In units of intensity.	c. Ratio of the intensity for the other eye.
8 c. p. lamp + 34 t. p.	1	$147\frac{1}{2}^\circ$	.41	.41	85°	.18	.18	$151\frac{1}{24}^\circ$	.41	.41
8c.p.+26t.p.	2.77	85°	.65	.23	$48\frac{1}{2}^\circ$	.37	.13	$157\frac{67}{96}^\circ$	1 21	.43
" 20 "	3.88	65°	.70	.18	$32\frac{1}{2}^\circ$	.35	.09	$156\frac{11}{72}^\circ$	1.68	.43
" 16 "	6.66	$66\frac{3}{4}^\circ$	1.31	.19	$30\frac{1}{4}^\circ$	.55	.08	$174\frac{11}{12}^\circ$	3.23	.48
" 12 "	16.16	$47\frac{1}{2}^\circ$	2.09	.12	14°	.64	.03	$197\frac{3}{16}^\circ$	9.12	.56
" 8 "	29.16	32°	2.59	.08	$10\frac{3}{5}^\circ$	.85	.02	$175\frac{1}{30}^\circ$	14.17	.48
" 4 "	56.94	$19\frac{1}{4}^\circ$	3.04	.05	$5\frac{7}{8}^\circ$	.90	.01	$174\frac{11}{96}^\circ$	27.51	.48
8 c. p.	100.00	$12\frac{1}{2}^\circ$	3.47	.03	$2\frac{2}{3}^\circ$	.74	.007	$145\frac{1}{6}^\circ$	38.20	.38
16 "	192.00	$10\frac{3}{8}^\circ$	5.53	.02	$1\frac{1}{2}^\circ$	.80	.004	$126\frac{89}{96}^\circ$	67.69	.35
32c.p.+4t.p.	527.70	12°	17.59	.03	$\frac{3}{4}^\circ$	1.09	.002	$103\frac{1}{3}^\circ$	145.91	.27
32 c. p.	1,014.80	5°	14.09	.01	*$\frac{5}{12}^\circ$(?)	1.10	.001	$117\frac{21}{80}^\circ$	330.54	.32
50 "	1,515.70	$3\frac{1}{3}^\circ$	14.03	.009	*$\frac{2}{3}^\circ$(?)	2.80	.001	$90\frac{103}{144}^\circ$	381.93	.25
100 "	3,130.40	$5\frac{1}{3}^\circ$	46.37	.01	*$\frac{1}{4}^\circ$(?)	2.17	.0006	$82\frac{7}{9}^\circ$	719.98	.22

*A partial stereoscopic effect sometimes remained at a point lower than the disc was graduated to measure.

TABLE II. OBSERVER L.

DESCRIPTION OF LIGHT USED.	PHOTOMETRICALLY DETERMINED INTENSITY OF LIGHT.	MINIMUM AMOUNT OF LIGHT NECESSARY FOR SECOND EYE IN ORDER TO OBTAIN COMPLETE STEREOSCOPIC EFFECT.			AMOUNT OF LIGHT FOR THE SECOND EYE INEFFICIENT FOR THE STEREOSCOPIC EFFECT.			AMOUNT OF LIGHT FOR THE SECOND EYE INEFFICIENT FOR THE BRIGHTNESS OF THE COMBINED VISUAL FIELD.		
		a. In degrees of the Episkotister.	b. In units of intensity.	c. Ratio of the intensity for the other eye.	a. In degrees of the Episkotister.	b. In units of intensity.	c. Ratio of the intensity for the other eye.	a. In degrees of the Episkotister.	b. In units of intensity.	c. Ratio of the intensity for the other eye.
8 c. p. lamp + 34 t. p.	1	225°	.62	.62	114°	.31	.31	$229\frac{7}{9}$°	.63	.63
8c.p.+26t.p.	2.77	$176\frac{2}{3}$°	1.35	.48	42°	.32	.11	$169\frac{1}{19}$°	1.26	.45
" 20 "	3.88	102°	1.02	.26	$26\frac{2}{3}$°	.28	.07	$177\frac{2}{3}$°	1.91	.49
" 16 "	6.66	$93\frac{1}{3}$°	1.72	.25	$16\frac{2}{3}$°	.30	.04	$156\frac{2}{3}$°	2.89	.43
" 12 "	16.16	80°	3.59	.22	$9\frac{2}{3}$°	.43	.02	$176\frac{1}{4}$°	7.21	.44
" 8 "	29.16	$34\frac{1}{3}$°	2.76	.09	10°	.83	.02	$173\frac{3}{4}$°	14.07	.48
" 4 "	56.94	$42\frac{1}{3}$°	6.70	.11	$4\frac{5}{7}$°	.67	.01	$186\frac{1}{4}$°	28.52	.50
8 c. p.	100.00	$28\frac{1}{3}$°	7.87	.07	$2\frac{2}{9}$°	.78	.007	190°	52.77	.52
16 "	192.00	$22\frac{1}{3}$°	12.00	.06	$1\frac{5}{8}$°	.89	.004	$146\frac{11}{14}$°	78.28	.40
32c.p.+4t.p.	527.70	5°	7.32	.01	$\frac{1}{2}$°	.73	.001	†$97\frac{1}{2}$°	142.91	.27
32 c. p.	1,014.80	7°	19.73	.01	*$\frac{1}{4}$°(?)	.73	.0007	$190\frac{1}{4\,8}$°	537.75	.52
50 "	1,515.70	$8\frac{7}{3}$°	37.36	.02	*$\frac{1}{5}$°(?)	84	.0005	$156\frac{1}{6}$°	657.50	.43
100 "	3,130.40	$15\frac{3}{4}$°	136.95	.04	*$\frac{7}{8}$°(?)	7.61	.0002	$173\frac{1}{1\,0}$°	1,505.58	.48

*A partial stereoscopic effect sometimes remained at a point lower than the disc was graduated to measure.
†Result of only one series.

TABLE III. OBSERVER K.

DESCRIPTION OF LIGHT USED.	PHOTOMETRICALLY DETERMINED INTENSITY OF LIGHT.	MINIMUM AMOUNT OF LIGHT NECESSARY FOR SECOND EYE IN ORDER TO OBTAIN COMPLETE STEREOSCOPIC EFFECT.			AMOUNT OF LIGHT FOR THE SECOND EYE INEFFICIENT FOR THE STEREOSCOPIC EFFECT.			AMOUNT OF LIGHT FOR THE SECOND EYE INEFFICIENT FOR THE BRIGHTNESS OF THE COMBINED VISUAL FIELD.		
		a. In degrees of the Episkotister.	b. In units of intensity.	c. Ratio of the intensity for the other eye.	a. In degrees of the Episkotister.	b. In units of intensity.	c. Ratio of the intensity for the other eye.	a. In degrees of the Episkotister.	b. In units of intensity.	c. Ratio of the intensity for the other eye.
8 c. p. lamp + 34 t. p.	1	110°	.30	.30	70°	.19	.19	†Undecided.		
8 c.p.+26t.p.	2.77	63°	.45	.16	47°	.36	.12	$164\frac{4}{9}$°	1.41	.50
" 20 "	3.88	50°	.53	.13	31°	.33	.08	$166\frac{1}{6}$°	1.79	.46
" 16 "	6.66	29°	.55	.08	14°	.25	.03	$180\frac{10}{33}$°	3.33	.50
" 12 "	16.16	23°	1.03	.06	9°	.40	.02	$172\frac{9}{28}$°	7.73	.47
" 8 "	29.16	15°	1.21	.04	3°	.24	.008	246°	19.92	.62
" 4 "	56.94	15°	2.37	.04	$3\frac{1}{2}$°	.55	.009	$170\frac{5}{6}$°	27.02	.47
8 c. p.	100.00	11°	3.05	.03	$2\frac{1}{2}$°	.69	.006	$131\frac{2}{3}$°	36.57	.36
16 "	192.00	$11\frac{1}{2}$°	6.13	.03	$\frac{1}{2}$°	.26	.001	$148\frac{1}{3}$°	79.11	.41
32 c.p.+4t.p.	527.70	$2\frac{1}{2}$°	3.66	.006	$\frac{1}{2}$°	.73	.001	135°	197.88	.37
32 c. p.	1,014.80	3°	8.45	.008	*$\frac{1}{4}$°(?)	.70(?)	.0006(?)	$113\frac{5}{6}$°	320.88	.31
50 "	1,515.70	2°	8.42	.005	*Not found.			$128\frac{4}{7}$°	541.32	.35
100 "	3,130.40	$1\frac{1}{4}$°	10.86	.003	*Not found.			$106\frac{7}{42}$°	926.49	.29

*A partial stereoscopic effect remained at a point lower than the disc was graduated to measure.

†On account of the dimness and orange color of the light coming through so many sheets of tissue paper, the monocular and binocular light intensities could not be discriminated very clearly.

TABLE IV. OBSERVER A.*

DESCRIPTION OF LIGHT USED.	PHOTOMETRICALLY DETERMINED INTENSITY OF LIGHT.	MINIMUM AMOUNT OF LIGHT NECESSARY FOR SECOND EYE IN ORDER TO OBTAIN COMPLETE STEREOSCOPIC EFFECT.			AMOUNT OF LIGHT FOR THE SECOND EYE INEFFICIENT FOR THE STEREOSCOPIC EFFECT.			AMOUNT OF LIGHT FOR THE SECOND EYE INEFFICIENT FOR THE BRIGHTNESS OF THE COMBINED VISUAL FIELD.		
		a. In degrees of the Episkotister.	b. In units of intensity.	c. Ratio of the intensity for the other eye.	a. In degrees of the Episkotister.	b. In units of intensity.	c. Ratio of the intensity for the other eye.	a. In degrees of the Episkotister.	b. In units of intensity.	c. Ratio of the intensity for the other eye.
8 c. p. lamp + 16 t. p.	6.66	112°	2.07	.31	32°	.59	.08	†192$\frac{2}{9}$° (?)	3.55	.53
8c.p.+12t.p.	16.16	90°	4.04	.25	22$\frac{1}{2}$°	1.01	.06	†231$\frac{1}{9}$° (?)	9.87	.61
" 8 "	29.16	110°	8.91	.30	32$\frac{1}{2}$°	2.63	.08	217$\frac{7}{11}$°	17.59	.60
" 4 "	56.94	90°	14.23	.24	25°	3.95	.06	187$\frac{1}{4}$°	29.61	.52
8 c. p.	100.00	22°	6.11	.06	9°	2.50	.02	98$\frac{1}{2}$°	27.31	.27
16 "	192.00	22°	11.73	.06	9°	4.80	.02	131$\frac{1}{4}$°	70.00	.36
32c.p.+4t.p.	527.70	55°	75.06	.14	1°	1.46	.002	115$\frac{5}{8}$°	243.08	.46
32 c. p.	1014.80	9°	25.37	.02	3°	8.45	.008	108$\frac{3}{4}$°	306.55	.30
50 "	1515.70	10°	42.10	.02	1$\frac{1}{2}$°	6.31	.004	†210° (?)	884.15	.51
100 "	3130.40	50°	434.77	.13	$\frac{1}{2}$°	4.34	.001	87$\frac{1}{2}$°	761.10	.24

* Owing to special conditions, the trials with this observer were not made with the three lowest intensities.
†The "equal" limits had not been passed at 135° on the disc.

The intensities of the lights used were measured relatively to each other by means of an episkotister photometer; in the table the intensity of the weakest light, that of an eight-candle power electric lamp, surrounded by thirty-four sheets of white tissue paper, is given as 1, and the others in comparison with it. The results of each observer are exhibited in a separate table. The second main division of the tables shows the lowest point for each absolute intensity at which the stereoscopic effect was complete, the third the point at which it had entirely ceased. Between these points there was a region of partial or incomplete combination. Here the objects were sometimes confusedly intermingled ; sometimes the complete stereoscopic effect would alternately appear and disappear, and again there would occur the phenomenon of competition of the vision fields, first one and then another set of lines becoming more distinct. The fourth division of the tables gives for each absolute intensity the amount of light which can be admitted to one eye without producing any change in the brightness of the common vision field. It will be observed that in this division the results are less regular than in the others. This is probably because: (1) The judgments concerning light intensity are more difficult than those concerning the stereoscopic effect, and to secure regularity would require the averaging of a greater number of trials; (2) With the lower intensities the tissue papers gave always a certain degree of color which had to be abstracted from in judging of the brightness, as the color would also change on the closing of the shutter; (3) These difficulties gave rise to a third source of irregularity, viz., that the observer had often to look for some time at the object before deciding, and in those cases, owing to the adjustment of the eyes, the results were probably somewhat different from what they would have been could the judgment have been given immediately. The results, however, appear sufficiently exact for the purpose of our comparison.

It is also noticeable that the results are less regular with very high absolute intensities, probably because these intensities are somewhat near to what, for the eye adapted to the low intensities of the darkened room, forms the "upper limit."

We may now attempt to estimate the significance of our results.

I. The amount of light required in the second eye to produce the stereoscopic effect seems with most of the intensities used surprisingly small. With very high intensities one one-hundredth of the full light, or less, was sufficient to make it complete, while a partial effect in many cases re-

mained with the very least amount which the disc could be adjusted to admit. Where episkotister values of less than 1° are given, no great reliance can be placed on their accuracy, as the disc was not graduated to measure smaller quantities than half a degree with exactness. Where such values are given in the tables, they represent the average of different results, in some of which the lowest intensity measurable was not low enough to make the stereoscopic effect disappear. On the other hand, with the lowest absolute intensities, about one-half the full light was necessary for the second eye in order to produce the complete stereoscopic effect, while for any stereoscopic effect at all, from about one-fifth to one-third of the full light was required. In connection with these results two problems are presented: (1) To account for the great difference between the proportion of light required for the second eye at low absolute intensities, and that required at high intensities. (2) To account for the wide range in all cases between the point where the objects begin to combine, and the point where the complete stereoscopic effect is obtained. The amount of light at the latter point is about from two to twenty times as great as at the former.

With regard to the first of these questions, there seems to be something more involved than mere proportionality; for while the amount of light required for the second eye increases regularly with the increase of the absolute intensity, the increase is not *proportionate;* so far from it, indeed, that the ratio of the intensities for the darkened and the undarkened eyes, instead of increasing or remaining constant, decreases so rapidly that it is from fifteen to one hundred times smaller at the highest than at the lowest intensities. This would seem to suggest that the coöperation of the two retinas in producing the binocular combination, is of so intimate a character that where one retina is not stimulated sufficiently to enable it to play its part in that combination, its energy may be supplemented by that of the other. If that be so, then naturally the greater the amount of light admitted to the free eye, the greater will be the energy which can be spared to supplement that of the partially darkened eye, and consequently the smaller the proportion of light required in the latter for the binocular combination. This point will be discussed more fully further on, but it may be noted here that by the *binocular* combination is not meant the *stereoscopic* combination. The factors of binocular depth perception are of course such that in it one eye cannot do any part of the work of the other. But in order to the production of the stereoscopic effect, it is first necessary that the two images should be combined so as to present the appearance

of a single surface ; and it is in this combination that the interpretation of our results seems to require the assumption that part of the energy of the retina of the free eye is directed to aiding the other retina. This hypothesis is supported by, and at the same time affords an explanation of, the second fact above noted, viz., that the amount of light admitted to the second eye at the point where the objects begin to combine is only a small fraction of that required for the complete stereoscopic effect. For if in the former case only the coincidence of surfaces takes place, and in that the free eye can aid the other, while in the latter there occurs the complete stereoscopic combination, it is evident that in the latter case the aid which the free eye can render to the other is proportionately much smaller, and consequently the proportion of light required in the second eye much greater than where the objects combine only as in a plane surface. This distinction of the binocular from the complete stereoscopic combination is not a merely hypothetical one, as throughout the course of the experiments it was frequently noted that the objects would coincide as a single surface where there was no depth effect perceptible.[1] In this case the lines did not combine, and, for the observer *L.* especially, one of the criteria for the completeness of the stereoscopic combination was that as soon as it began to be incomplete, he had "double images" of the small central squares.

II. The "indifference point," or point of inefficiency as regards the comparative light intensities of monocular and binocular vision, varies also in correspondence with the absolute intensity ; the amount of light which can be admitted to the second eye without affecting the brightness of the common visual field increases regularly with the increase of the absolute intensity. The ratio of the amounts of light admitted to the obscured and the unobscured eyes shows, however, at this "indifference point" less variation than at the lowest point of effectiveness for the stereoscopic combination. In this connection there are three points which seem to require explanation : (1) That so large a proportion of the full light, varying, with different absolute intensities and different observers, from about one-fifth to nearly two-thirds, can be admitted to the second eye without increasing the total brightness ; (2) That while the amount of light for the second eye inefficient for the brightness of the combined visual

[1] For the further elucidation of this point, *i. e.*, the possibilities of binocular combination, *vide* the tables appended to Dr. Kirschmann's article on "Metallic Lustre and The Parallaxis of Indirect Vision," *Philos. Studien*, Vol. XI, 1895, pp. 147-189.

field increases in quite regular correspondence with the absolute intensity, the increase here, as with the light required in the second eye for the stereoscopic effect, is not proportional, so that while the actual amount of light increases, the ratio to the full light continuously decreases; (3) The paradoxical phenomenon, viz., that below the "indifference point" the closing of the partially darkened eye causes a brightening of the common visual field, *i. e.*, a decrease of intensity of physical stimulus results in an increase of intensity of light sensation. With regard to the first of these points it is only necessary to recall the fact that the purpose of the two eyes is not to increase the intensity of light sensation, but to localize objects in space. The second and third points are somewhat closely related, and will be dealt with together in the next paragraph.

III. What is the bearing of our conclusions upon the two suggestions which formed the starting point of the investigation?

1. With reference to the suggested explanation of the "paradoxical experiment" of Fechner. If the experiments confirm this suggestion, the explanation of the paradoxical phenomenon will be quite simple: So much of the energy communicated to the retina of the second eye goes to combine the two retinal images and localize in space the combined image, the remainder, subject, of course to the law of Weber, goes to increase the light intensity of the combined visual field; or, where the energy which reaches the second retina is insufficient to produce the stereoscopic effect, part of the energy is subtracted from the other retina to aid in combining the objects, and the result is a darkening of the common visual field. To confirm this suggestion the results should show a practical coincidence of the "indifference point" of light intensity and the lowest point of effectiveness for the stereoscopic effect. Now, on reference to the tables, it will be seen that the "indifference point" is very much higher in nearly all cases than the point below which the stereoscopic effect ceases to be good; the lower the absolute intensity, however, the nearer these points approach each other, and at certain extremely low absolute intensities they practically coincide. This would seem to indicate that the explanation holds good for these low intensities; the question at once arises, "Why not for higher intensities?" This may be explained quite readily on the supposition that at such low intensities as are denoted in the tables by 1 and 2.77, the light which reaches the retina of the unobscured eye is very little more than sufficient to enable that eye to perform its part in the binocular combination. This supposi-

tion is supported by the fact observed throughout the experiments, that with these very low intensities, at the lowest point where the stereoscopic effect was obtained, the outlines of the objects were not clearly visible with the darkened eye alone, while with higher intensities they were visible with the darkened eye below the point where the stereoscopic effect had ceased to appear. Assuming this supposition to be correct, what bearing will it have upon our results? If we take, for example, in Table 1 the absolute intensity 1, we find that the light which must be admitted to the second eye to produce the complete stereoscopic effect is represented by .41, and .41 also represents for the absolute intensity 1 the amount of light for the second eye, which has no effect on the light intensity of the common visual field. If less light than .41 is admitted to the second eye, therefore, we shall have the "paradox," and we shall not have complete, but only partial stereoscopic effect. Why is this? Apparently because the stimulus applied to the second eye in this case is not sufficient to produce the energy required for the stereoscopic effect. Part of the energy appears to be subtracted from the other retina to aid in the binocular combination, and consequently the common visual field is darkened. But because the energy communicated to the free eye is little more than is needed to produce the required effect in it, there cannot, while that eye continues to discharge its function, be sufficient energy withdrawn from it to make up what is lacking in the other eye, and hence the stereoscopic effect remains incomplete. Then taking a higher absolute intensity, say that represented in the table by 100, we find that the amount of light for the second eye required to produce the complete stereoscopic effect is 3.47, while the amount inefficient for the brightness of the combined visual field is 38.20. Now, on our theory it may be held that the energy which reaches the retina of the free eye is in this case more than is required for that eye to play its part in the coöperation of the two eyes, and where the other eye does not receive sufficient for that purpose, enough energy may be subtracted from the free eye to supplement that of the partially obscured eye, and produce the complete stereoscopic effect. This would account for the fact that with all but the lowest intensities, there is a region, growing more extended as the absolute intensity increases, where the paradoxical phenomenon occurs, while yet the stereoscopic effect is completely preserved.

2. With reference to Fechner's and Aubert's "minimum" and "conjugate points," the suggested explanation

was that below the "minimum point," *i. e.*, the point of greatest darkening in the common visual field by the partial obscuration of one eye, there is no binocular combination, so that all the light admitted to the second eye may go to increase the total brightness; while, on the other hand, above that point, the additional light is not needed for the stereoscopic effect, and so may go to increase the light intensity of the combined visual field. This at first seems also to obtain at least a partial support from the results, as at low intensities—in Tables I and II that denoted by 2.77,—the point where the stereoscopic effect ceases to appear, is rather near the "minimum point" of Fechner and Aubert, namely, .122 of the light admitted to the undarkened eye. There does not, however, appear to be in this case any satisfactory explanation of why these points do not coincide as well at higher intensities, so that their practical coincidence at this one intensity may be merely accidental. Moreover, this explanation would require that as the light admitted to the second eye is decreased, the stereoscopic effects continue complete down to a certain point, and below that point entirely disappear. This, as we have seen, is not the case; below the point where the combination ceases to be complete, there is a rather extended region of partial or incomplete combination. The difficulty seems to be that the fixing of the "minimum point" definitely at .122 is itself not to be relied on, for (1) reference to the tables shows that though the ratio to the full light of the light required for the second eye to produce any effect on the total intensity remains within comparatively narrow limits fairly constant, yet on the whole that ratio varies in correspondence with the absolute intensity, and (2) it must be remembered that the "indifference point" is not usually a single definite point, but that there is usually a considerable region within which no difference in the light intensity of an object in the common visual field is observed when the object is regarded alternately with one eye and two, and the figures in the tables represent simply the averages of all the equal cases.

Résumé.

I. The amount of light required for the second eye to produce the stereoscopic effect, is, especially with high intensities, very small.

II. The amount required depends on the absolute intensity.

III. There is a considerable range between the lowest

point where the objects combine, and the point where the complete stereoscopic effect is obtained.

IV. The amount of light for the second eye inefficient for the total brightness corresponds to the amount required for the stereoscopic effect only at very low intensities; at higher intensities it is much greater.

V. The results seem to indicate a coöperation of the two retinas of so intimate a character as to afford a ground for the explanation of Fechner's "paradoxical experiment."

VI. The distinction between simple binocular coöperation and complete stereoscopic combination, noted in the course of the experiments, presents a problem for further research.

ATTENTION: EXPERIMENTAL AND CRITICAL.

By Frank Drew,
Late Fellow in Psychology, Clark University.

Outline. I. Some slight additions to the reported experiments on Attention. II. A brief historical sketch of the subject. III. The writer's views. IV. A summary of by-products of the experiments which suggested, and in turn get meaning from, the view held. V. Bibliography.

I.

At the outset there will be no attempt made to define Attention; the word will be used in its ordinary sense. The experiments to be described, and which were performed in the laboratory of Clark University, fall into three general groups. In the first, use was made of perception, association and reaction time; in the second, perception and association; in the third, perception only. In these groups the question set was always: What differences, if any, can be found in the results of a given task performed on one occasion with concentration, at another with distraction of attention?

A. Reaction-Time.

This series, carried on in the winter of 1893-4 and fall of 1894, aimed to combine tasks of various degrees of difficulty with distraction of various degrees of effectiveness. Its object was to arrange a series of tasks of increasing degrees of complexity which should make ever greater demands on the mind, until attention should pass from a fully concentrated to a completely distracted state. The work was begun in full sympathy with Wundt's position, and, indeed, was understood as but a mere continuation of the course begun by him and others.[1] The experiments with five subjects[2] were as follows:

I. Multiplication table up to 12×12, factors given in four sets of eighteen couplets each, in hour sittings, first and last sets with concentrated attention and signals; second and third without signals and with distraction. The distraction consisted of: reading text (1) silently, (2) aloud; naming letters (1) in direct order in text, (2) in reverse order, (3) on drum, seen one at a time; fixation of one letter seen through a slit. Further work was given also in multiplication, *e. g.*, 6×19, etc. The factors were given (1) orally, circuit closed with last factor, (2) by Fall-apparatus. Reading, for purpose of distraction, was (1) stopped when last factor was given, (2) continued until after answer was got. Reactions made by finger key and with mouth key; to be made in shortest possible time.

II. Stimuli—(a) by *Fall-apparat:* (1) letters, (2) colors, (3) diagrams, *e. g.*, crescent, star, circle, triangle, cross, (4) factors to be multiplied, (5) numbers from one to ten; (b) oral: factors and

[1] Phys. Psych., 4th ed., Vol. II. Chap. XVI, and *Mind*, Jan., 1895, p. 79.

[2] Besides the writer these were Dr. E. C. Sanford, Mr. A. H. Yoder, Mr. A. C. Ellis and Mr. J. R. Slonaker. To these gentlemen I am greatly indebted for many months of careful work.

numbers as in (4) and (5). Reactions made on five and ten-fingered keyboards were semi-adaptive, or with from one to all the fingers of one or of both hands. Stimuli were given in four sets: first and last with free attention and ready signal; second and third with distraction and no signal.

The times were taken chiefly by the Hipp chronoscope, though other methods were used. The figures obtained are regarded as unsatisfactory, though in passing it should be said they are in substantial agreement with those obtained by other experimenters working under like conditions. Greater stress is laid on the observations made during the course of the experiments on external and introspective accompaniments; rather full notes kept of these will be given in connection with similar data got while carrying out other lines of experiments.

B. Association Experiments.

Association experiments were performed in spring of 1894, to find in what degree, if any, the process and variety of strictly relevant associations are affected by concentration and distraction of attention. The material consisted of four sets of cards prepared for me, 100 in each, on which were written words, grouped as follows:

	I.	II.	III.	IV.
Common nouns,	64	57	57	66
Proper nouns,	2	4	2	6
Nouns or verbs,	21	24	34	22
Abstract nouns,	8	8	7	5
Adjectives or nouns,	4	6	0	0
Adjectives,	1	1	0	1

Each set was taken twice, with an interval of a month; the results of each first trial were not looked at nor thought about during the interval. Tables A and D show the order in which the sets were taken and repeated. Distraction was got by adding columns of logarithmic tables; five groups of these—vertical,—with five figures in each group, were taken as a stint; the plan followed was to add the first group, and while passing up to the next, to glance at the card, catch the word, and go on with the addition. The figures were at my right, the pack of cards at my left, and not to be seen save by special effort; the figures were covered either by thumb or by a card held in left hand, and were exposed singly. With concentrated attention the time allowed (fifteen seconds) was kept by a clock striking quarter-minutes. (Cf. Bergström, American Journal Psychology, Vol. VI, p. 248.) In this portion of the work the cards were on the table before me, hid by a block. As the clock was about to strike, I leaned forward with eyes on wall, and dropped them on the word at the stroke. All unrelated "associations" were ruled out, inhibited at once. At times this practice worked against the reception of some rightful though unrecognized claimants, and these, now and then, continued to press their claims until admitted, though often they were seen aright too late to be included within the time limit. After each trial the associations were jotted down, and then dropped from mind as quickly as possible. Work was usually done in hour shifts in the morning. Average time per word (inclusive of time taken to write out the associations, etc.) was with concentrated attention, 2.2 minutes; with distracted, 2.4 minutes. The latter is a little greater, but it includes the time taken to check the additions.

Because of differences in method it is impossible to make a sta-

tistical comparison with Galton's work,[1] but it may be well to call attention to the fact that Galton selected his words, and thus began with a set of associations; repetition of these would but fix them deeper. It is probable, too, that a large part of his list were suggested by matters new in his mind. As did Galton, so do we find any attempt at classification of one's mental furniture sure to be unsatisfactory. Eye, ear, and motor-mindedness may be convenient groupings in a discussion, but are inseparable in the mind. The conditions of the experiments were such as to cause a strong bias to internal speech. The words used were repeated mentally, and the process of association was with us begun often before the object for which the word stood was fairly realized; often not the object itself was got, but instead a strong sense of its location and place associates. Mere verbalisms, puns, catch phrases and the like were frequent; irrelevant pseudo-associations, *i. e.*, associations of associates, were a pest difficult to escape. It was less easy to pick out those cases wherein the eye was caught and associations suggested which were not strictly pertinent; by eye were often recalled derivatives of the root whence the keyword came,—though one could not be sure the associates did not join directly to the root-meaning. Visualization was common; localization was seldom absent. Results are as follows:

TABLE A. NUMBER AND DISTRIBUTION OF ASSOCIATIONS.

	1		2		3		4		Sum of α(1-4) a	Sum of β(1-4)a	Sum of β(1-4)b
	a	b	a	b	a	b	a	b			
I. *a*. Distracted Att.	116		130		74		17		337		
β. " "	52	49	87	61	44	36	15	6		198	152
	168		217		118		32				
II. *a*. Concentrated Att.	120		185		108		10		423		
β. " "	43	66	92	80	40	37	16	3		191	186
	163		277		148		26				
III. *a*. Distracted Att.	147		166		74		7		394		
β. Concentrated Att.	70	93	86	95	50	42	26	2		232	232
	217		252		124		33				
IV. *a*. Concentrated Att.	138		162		83		6		389		
β. Distracted "	41	89	80	92	43	36	22	5		186	222
	179		242		126		28				

1, First two-fifths of life; 2, second two-fifths; 3, last fifth, save 4, the immediate past.
a, New associations in first and second trials; b, repeats.

[1] Cf. Bibliography at end.

TABLE B. DISTRIBUTION OF ASSOCIATIONS WITH CONCENTRATION AND DISTRACTION.

	1	2	3	4	Sum	
Concentrated Attention,	371	525	281	58	1235	52.55%
Distracted Attention,	356	463	235	61	1115	47.45%
	727	988	516	119	2350	100.00%
Repeats,	297	328	151	16	792	

Table B is derived from Table A; *e. g.*, from column 1 a, 120+43+70+138 = 371; etc.

TABLE C. DISTRIBUTION BY PER CENTS.

Of the 2,350 new associations

		Concentrated.	Distracted,
30.93%	Come under 1,	15.78%	15.15%
42.04%	Come under 2,	22.34%	19.70%
21.96%	Come under 3,	11.96%	10.00%
5.07%	Come under 4,	2.47%	2.60%
100.00%		52.55%	47.45%

TABLE D. NEW ASSOCIATIONS ON SECOND TRIAL.

I. Distraction, followed by same,	337	62.99%
	198	37.01%
	535	100.00%
II. Concentration, followed by same,	423	68.89%
	191	31.11%
	614	100.00%
III. Distraction, followed by Concentration,	394	62.94%
	232	37.06%
	626	100.00%
IV. Concentration, followed by Distraction,	389	67.65%
	186	32.35%
	575	100.00%

Table D is derived from Table A, third and second columns from the right.

TABLE E. REPEATS ON SECOND TRIAL.

I. Distraction, followed by same,	337	100.00%
	152	45.10%
II. Concentration, followed by same,	423	100.00%
	186	44.00%
III. Distraction, foliowed by Concentration,	394	100.00%
	232	58.88%
IV. Concentration, followed by Distraction,	389	100.00%
	222	57.07%

Table E is derived from Table A. third and first columns from the right. Of 337 associates got on first trial, 152 recurred when the series was repeated a month later.

TABLE F. ASSOCIATIONS BY KIND; FIRST ASSOCIATIONS ONLY, NO REPEATS.

Concentrated Attention.

	Concrete.	Verb.	Story.	Word, &c.	Reason'g.	Sum.
II. 1 and 2,	230	28	153	114	81	606
III. 2,	87	13	41	58	33	232
IV. 1,	171	25	75	89	25	385
Sum,	488	66	269	261	139	1223
Percentage,	40	5.4	22.	21.3	11.4	

Distracted Attention.

I. 1 and 2,	214	19	143	93	48	517
III. 1,	175	34	83	76	23	391
IV. 2,	58	5	64	35	23	185
Sum,	447	58	290	204	94	1093
Percentage,	40.9	5.3	26.5	18.6	8.6	

Hampered by the conditions—in a limited time to get the greatest possible number of direct and good associations to a seen word,—the work was of course in some respects not normal. The number of associations got with concentrated is but little more than with distracted attention,—evidently because especial effort within the time limit was nearly equivalent to the distraction. Ranging was precluded by the conditions, though ranging is required in

order either to get new associations, or at least to dip into these when found. A comparison of sets III and IV, Table A (see especially the second column from the right, 232 against 186), indicates that to end an experiment with close attention enables one to clean up his scattered associations, though in several instances the commonest associates were not found. "Clock" gave me clocked stockings, but not a time-piece; "school" gave school of fish, and to school, *i. e.*, discipline one's-self, but not an inkling of the many schools attended or taught. In many cases it is difficult to satisfactorily assign the associations to their proper period of life. When they first occur—under the conditions of the experiment—they are most often fragments, nodes of a network, whose connections trouble either by lack or overabundance. One thing, however, is commonly well marked: that recent events are hard to remember when the stress is great. The period included under 4 was limited to a few days preceding the tests, and its incidents were sights, conversations and other such matters as are usually totally forgotten in a short time. Tables B and C show how slight, under the conditions, was the influence of attention. Of the determinants of association given by James (Vol. I, p. 577) recency and the oldest habits fall out in an examination of this sort.

Under D a comparison of I and III with II and IV, shows disturbing effect of distraction on first trials, since in I and III was got a less per cent. of the whole number of new associations than in II and IV. Yet an examination of the results of the second trials of the same sets shows no marked differences due to conditions of attention. In Table E, comparison of repeated associations, the most striking feature is the marked uniformity of the repeat-percentages under like requirements. The increase in the number of repeats shown in A and E, probably indicates growth in ease and habituation in performing the experiments, though it should be said that in the earlier part of the work, repeats, which returned with force, were turned down as unprofitable material, and greater effort was made to hold close to the key-word. As the work grew more familiar, the repeats were recognized, noted and passed with little trouble, and thus more of them found place in the final reckoning. Although the repeats were more or less bothersome, still from the start they seemed empty, persistent, yet worthless; as the work progressed they became less insistent, — mere echoes of the former trials. As the mind became adjusted to the conditions, the ideas which gathered about the key-word tended to form groups and to return *en bloc*. As for the addition, it soon ceased to be much of a distraction, in the sense of a source of flurry,—although when series of like or of small numbers occurred they proved to be very confusing. Accustomed to an irregular gait, both in the compulsory hunt for associates and in the addition of unlike numbers, the mind could only with great difficulty curb itself for a uniform series. Series such as 4-3-2-1-0, 2-2-2-2, or 5-1-5-1, would almost inevitably cause a break in the work. In fact the attempt to do orderly, *i. e.*, continuous, work was more distracting than the distraction, — true, of course, only because the conditions were such as to make the work an alternating one. Whether the alternation was from word to figure or from an associate back to the key-word (for it was required that each associate should be connected with the given cue), in either case irradiation, or growth of an idea, was hindered. Some words that suggested few associates occasioned slow diffusion about a centre (where the mind stuck), either through attempts at derivation, or by more or less

confused lines of reasoning. But these efforts tended to vagueness, whereas the conditions called for many and definite associations; and so it came about that fatigue, whereby the temptation to range was cut off, proved an aid to lessen the power of the distraction to control one's attention, and in this way permitted greater skipping.

A most striking feature of the work was the spatial setting given to almost all the associates save a few mere verbalisms. This localization was felt as a muscular tension toward the object named, which in turn needed a setting to give it the tang of reality. Almost equally necessary was the conscious inner arrangement of the associations, which had to be created into some muscle-tension form (usually a word) in order to be carried subject to recall. Words that offered little occasion for tangible (in the main visible) experience, and which for this reason had few concrete space locations, were usually confusing, *e. g.*, will, meditation. The confusion sprang from great familiarity with meanings which wanted concise muscular expressions; words with less used content, *e. g.*, continuity, plurality, were quickly placed in some book or conversation.

Refractory though the material was, a classification was made of it according to kind, as shown in Table F. The limits of these groups are as follows: Concrete, a well visualized object. Verb, some specific act suggested by the verb key-word. Story, recalled by key-word. Word, mere verbalisms, puns, proverbs, etc. Reasoning includes, in greater part, the cases of diffusion noted above. Examples are: with "nut" was associated Piñon Jay (*Gymnocitta cyanocephala*), which, though ruled out, hovered in the shadow until one of its synonyms—*nucifraga*—came up. "Enchantress" gave me *Circæa lutetiana*, the enchanter's night shade, and set my thoughts as follows: Night shade—a poison—poisons act on the body—so do Circean smiles; then came a vague notion of James' theory of emotions, and of controlling one by his emotions. The propriety of admitting this last group (reasoning) may seem questionable because its examples were not so directly referred to the key-word, yet in truth it is hard to say how many of even the verbalisms were got by a movement straight from the stimulus.[1]

C. Least Interval.

In the American Journal of Psychology, Vol. VI, is an article by Miss Alice J. Hamlin on the "Least Observable Interval between Stimuli addressed to Disparate Senses and to Different Organs of the Same Sense," wherein, pp. 572-3, are noted results of experiments with forced attention, and the conclusion "that voluntary attention is ineffective." The experiment of perceiving closely following stimuli with concentrated and distracted attention, was continued by the writer, with results as follows:

The apparatus used was composed of the pendulum circuit-breaker[2] in connection with (a) two telephones worked by the secondary circuits of sliding induction coils; (b) iron cups filled with water, into which were plunged the fore and middle fingers of each hand—shocks mediated by induction coils; (c) for a few trials a contrivance to produce a snap, when the stimuli were a shock to a hand and a snap by one ear, made as the current jumped a break. The interval for the click and also for the shock experiments was 24σ; that for the click-shock series was 31σ. In the case

[1] See also results of experiments on S. given in a note at the close of this article.
[2] American Journal Psychology, VI, p. 581.

of the former the interval was not "the least" which could have been used, but was taken because a range was desired within which attention could be manipulated; the interval used in the click-shock experiments was probably a little too short, as will be shown in another place. Our custom was to give an equal number of stimuli in R-L and L-R order, though of irregular sequence, in sets of twenty, save in the variable series, where forty made a set; each trial was preceded by a warning signal (click of a telegraph sounder) to ensure the subject's readiness. Operator and subject were in separate rooms, with only telegraphic connections.

1.

Work began with stimuli to separate organs of the same sense, in this case with clicks of medium intensity.

1. Medium Clicks.

Date.	Subject.	Indifferent Att.		Directed Attention.			
				Right First.		Left First.	
		R.	L.	Att. right.	Att. left.	Att. right.	A. left.
Feb. 20-Mar. 8.	S.	75-87	75-80	49-41	44-59	43-88	48-75
Feb. 20-Mar. 7.	D.	100-90	100-72	53-57	50-90	46-87	54-50

In each column the figures first given represent the number of trials, the second set represents the percentage of correct answers.

With indifferent attention appears a trend to the right in both subjects. Both subjects also show that attention lessens the number of correct answers for the attended side. Attention to the left enables S. to overcome the bias to the right shown in the indifferent set; D. shows a strong tendency to go opposite the direction of attention. These features prevailed more or less throughout the work and will be commented on later.

Although the stimuli were adjusted so as to appear equal, and were tested before each sitting, yet they were almost always modified by subjective influences; for a time we were continually stopping for tests to see if the apparent differences in intensity were due to objective causes, and in order to neutralize any unavoidable differences in the apparatus, the terminals, telephones and cups were interchanged by sets, so that stimuli, *e. g.*, to the right side, should come an equal number of times through each terminal. As this matter of intensity played so large a rôle in the formation of order-judgments, our next experiment was with alternating series of medium and faint clicks—attention indifferent, since our aim was to get the naïve bias, if any. Of each group of four sets of twenty each, one and three—medium and faint respectively—were taken by one subject, two and four, duplicates of the other pair, by the second subject. Whilst as thus coupled there was much introspection on the "faints," yet when set off in series these were treated by the subjects apart from and with no conscious reference to the louder series.

2. CLICKS: MEDIUM AND FAINT. INDIFFERENT ATTENTION.

DATE.	SUBJECT.	MEDIUM.		FAINT.	
		Right First.	Left First.	Right First.	Left First.
Mar. 6-8, and 13-23.	S.	120-83.3	120-86.6	120-75.8	120-80.8
Mar. 6-8, and 13-23.	D.	120-81.0	120-78.0	120-79.0	120-70.0

In this group there is no trace of any bias to the right in S.; in D. it remains.

Continuing the comparison of intensities, we arranged the induction coils so they could be varied at the pleasure of the operator,—though the range of variation was limited to what was noted by each subject, *when testing*, as "just observably different." The series were short, and gave results as follows:

3. VARIABLE CLICKS: INDIFFERENT ATTENTION.

DATE.	SUBJECT.	Right First.		Left First.	
		R. Loud.	L. Loud.	R. Loud.	L. Loud.
April 5-10, June 10-19.	S.	79-63	79-75	78-77	79-72
April 6-10, June 10-12.	D.	45-11	49-86	45-96	48-58

Both subjects give preference to the faints; with D. the habit is extreme.

The electric-shock stimuli were used under the same general conditions of interval and order that governed in the use of telephones; the results of the main series are as here given.

4. SHOCKS: MEDIUM.

DATE.	SUBJECT.	INDIFFERENT ATT.		DIRECTED ATTENTION.			
		R.	L.	Right First.		Left First.	
				Att.right.	Att. left.	Att.right.	A. left.
Apr. 12-May 9.	S.	200-93	200-45	103-86	97-76	97-41	103-64
Apr. 12-May 8.	D.	200-80	200-70	90-82	110-71	104-61	96-60

Note the bias to the right, especially in S. To direct attention to shocks is a very different matter than in the click series; this matter will be treated further under the introspective comments. In the same section will be noted an interesting illusion, found while we were working with crossed hands.

In order to test a lurking inference that voluntary attention did not aid, and possibly hindered, judgments of the time order, a few series were taken with "distracted attention," got by reading aloud, at a rapid rate, interesting "short stories." Each series was preceded by one of the usual kind—indifferent attention—in order to tune up our minds. The indifferent series was preceded by the customary ready signal; the stimuli of the distraction sets came unawares and at irregular intervals.

5. SHOCKS WITH DIVERTED ATTENTION:

DATE.	SUBJECT.	INDIFFERENT.		DIVERTED BY READ'G	
		R.	L.	R.	L.
May 30, and June 7-8.	S.	40-58	40-53	60-73	60-53
May 30, and June 7-8.	D.	50-64	50-60	60-75	60-61

The only effect seems to be to give the bias to the right greater play and thus to increase the whole number of correct answers on that side.

As with the clicks, so with the shocks were taken series with variable intensities. With one exception, when right led for D., both subjects went with the fainter intensity. But the series are too short to be more than suggestive.

6. SHOCKS: UNIFORM AND VARIABLE.

DATE.	SUBJECT.	UNIFORM, MEDIUM.		RIGHT FIRST.		LEFT FIRST.	
		R.	L.	R. Strong.	R. Faint.	L. Strong.	L. Faint.
June 20.	S.	20-55	20-55	20-60	20-80	20-50	20-80
June 20.	D.	20-85	20-80	20-60	20-55	20-65	20-80

2.

By means of telephone and cup, stimuli were given to disparate senses, one ear and the fore and middle fingers of one hand. The interval used was 31σ.

7. SHOCK AND CLICK.

DATE.	SUBJECT.	INDIFFERENT ATT.		DIRECTED ATTENTION.			
		Shock.	Click.	Shock First.		Click First.	
				Att. on S.	Att. on C.	Att. on C.	Att. on S.
June 13-18.	S.	100-91	100-51	94-93	106-79	94-71	106-75
June 13-18.	D.	100-98	100-19	103-76	97-99	103-38	97-85

The most prominent feature of this series is the influence of directed attention to even up the very unequal portions got with indifferent attention. The readiest explanation of the facts is that the interval between stimuli was too short to permit the mind to adequately judge the order in the indifferent set, and that in the press the stronger, *i. e.*, more expansive, shock overbalanced the click. The interference of attention aided D. in that it served to turn his judgments in the contrary—and usually correct—direction.

It may be of interest to note the inner uniformity of the various series, and to this end the following tables, 8-11 inclusive, are submitted; figures give percentage of correct answers:

8. Click Series by Halves.

Subject.	Indifferent Att.		Directed Attention.			
			Right First.		Left First.	
	R.	L.	Att. Right.	Att. Left.	Att. Right.	Att. Left.
D. I.	88	72	64	92	96	38
D. II.	92	78	52	88	61	92
S. I.	100	71	53	57	86	86
S. II.	75	86	21	62	90	58

9. Shock Series by Halves.

Subject.	Indifferent Att.		Directed Attention.			
			Right First.		Left First.	
	R.	L.	Att. Right.	Att. Left.	Att. Right.	Att. Left,
D. I.	75	62	87	62	60	64
D. II.	85	78	78	80	61	57
S. I.	91	57	80	78	51	67
S. II.	95	33	94	75	33	60

10. Click and Shock Series by Halves.

Subject.	Indifferent Att.		Directed Attention.			
			Shock First.		Click First.	
	S.	C.	Att. Shock.	Att. Click.	Att. Click.	Att. Shock.
D. I.	96	18	78	100	24	82
D. II.	100	20	74	98	51	96
S. I.	90	52	96	84	67	71
S. II.	92	50	89	75	76	80

11. Series by Halves Composed of First and Second Ten of Each Set.

Subject.	Series.	Indifferent Att.		Directed Attention.	
		I.	II.	I.	II.
D.	Clicks	77	79	70	73
D.	Shocks	75	75	67	70

3.

What, now, has introspection to say as to the subjective features of the work? Foremost is the fact, for D. at least, that the order of discrimination is from whole to parts; as the stimulus is repeated it grows in complexity. Other things being equal, in each new series and in every variation of a series, the judgments came promptly at first, and with a feeling of certainty that was fairly justified. But the feeling of ease passed away as introspection burrowed and disclosed differences before unsuspected. So it was that as we worked on, introspection notes accumulated at a growing rate, and we came at times to doubt the worth of series which actually showed a good preponderance of correct answers. Despite the fluctuations, however, two chief methods of judging were used: (1) A relatively immediate, sensory way, called "alert indifference" by Miss Hamlin (p. 574), and (2) a relatively conscious and reflective way. "*Relatively*," for we were not ordinarily conscious of such forms; whenever a case got loose from its immediate sensation-feeling, and thus made its order a matter of pure judgment, it was rejected, and the stimuli were repeated. Records were kept of these repeats (which do not figure in the tables given, and which were at times many), but as yet nothing definite has come from their study. For reasons to be given later, I believe these two forms of judgment to be stages of one process; nevertheless, to introspection the former is passive, the latter has a shade of action. Of the latter there are

two well-marked kinds, *a* and *b*. Mention has been made of the subjective differences interjected into the sensations by causes and ways thus far untraced; directed attention complicates the matter, but the reference now is to the indifferent attention sets, and chiefly to the fact that the intensities of each pair of stimuli differed subjectively, fluctuating capriciously both in degree and order. For a while the struggle—in cases when judgment lagged—was between a "feeling" and a "time" order, the two kinds listed above, *a* and *b*; introspection brought out that this time order depended on the relative intensities of the stimuli, which in turn were controlled by conditions of (1) end-organ responses, (2) general body state. One form of reasoning that slowly grew clear was: The two stimuli are objectively equal; subjectively they are unequal. One is fainter, hence farther away. But it cannot be more distant in space, hence it must have preceded the other. Another line of thought was: Into a uniform state of alert indifference or expectant attention comes a stimulus which, with a clear field, seems strong. Hard after the first comes a second, which by contrast seems faint. D. found himself controlled by the former—prejudice or bias rather than course of reasoning; S., and especially several on whom side tests were made, followed in part the latter. It should be kept in mind that the sensory, *i. e.*, passive, form—when got—furnished the most satisfactory results, because so free from any perception-fringe. An extreme of this form is found in the common experiences of life when two stimuli are separated by so great an interval as to leave no chance for doubt as to their order. The same feeling of sureness of order which accompanies the perception of well separated stimuli was present now and then, sometimes relating to isolated cases, again extending to whole series; yet the subjects at times were confident of what were, in reality, faulty sets, and again doubted correct ones. The individual cases checked immediately by D. as surely correct, give results as follows: (In each couplet the first number gives the whole number of cases checked "sure;" the second number gives the per cent. of correct answers.)

12.

Indifferent Attention.	Directed Attention.	Distracted Attention.
250-82	155-79	28-93

The freer one's mind is of anticipations of the stimuli, the better are his judgments.

The sensory form, recognized as purely passive, of course was beyond our control, and to be got only by a happy combination of circumstances. But commonly it was easy to sense the things we ought not to have done, for these were willful, though well-meant, interferences with perception. To direct attention is not an easy matter when one is prone to over-much introspection. Concentration on an ear was characterized by a strain in the ear muscles, and another, with a sense of looking fixedly, about the eyes. Attention to a hand often degenerated to a stupid stare until the plan was formed to slightly raise the hand, as if "hefting" it, at the same time slightly innervating the fingers. By this means attention was known to be *in* and not merely toward the hand, and "inner" and "outer" attention were made to coincide. The state known as

alert indifferent attention is really a state of general qualitative attention (for irrelevant matters are unheeded), with a focus of concentration in the median plane. Often during a series, as fixation grew more exact, what was at first a mere point of regard became a surface like the saddle-backed "specious present." The subject felt that the slightest wavering of attention to one side the imaginary centre would cause a bias in judgment to the favored side; then the criticism spread to his head, eyes, shoulders, and even to the equal expansion of the lungs. Because of this irradiation D. continually shifted his focus, ranging from a spot on the ceiling to one on his neck-tie, and tried some series with closed eyes. S., on the contrary, clung, as a rule, to a spot on the table at which he worked. Of the whole number of trials with directed attention, D. had 69% correct to S.'s 71%.

As might be expected in this interplay of fixation strains, there was now and then a passive state when the sensory form of judging found entrance. In truth these sensory judgments may safely be taken to mark the only times when attention was really alert and neutral, and the other cases, even of those in the nominally indifferent series, belong to more or less conscious work, as characterized by tensions. D., more troubled by introspective fancies, began early the practice noted above of putting himself into varying attitudes in order thereby to get new mental states, since the latter proved more favorable to the presence of the so-called passive judgments. S., on the other hand, was not troubled greatly by introspection until well on in the work, when he, too, became conscious of what seemed determining factors in the formation of judgments. A result of the change of method in his case is shown in the following table by the difference in the percentage of correct answers:

13. Table to Show Result of a Change in Method of Judging.

Date.	Clicks.		Date.	Shocks.	
	Indiff. Att.	Direc. Att.	Apr. 12-May 9.	Indiff. Att.	Direc. Att.
Feb. 20-Mar. 8.	83%	66%	First half.	74%	69%
June 11-19.	61%	67%	Second half.	64%	65%

Comparison of the earlier and later click series shows the superiority of the naïve form. The shock series, which came between the two click series, aids in tracing the gradual loss of the sensory form. In the first half the indifferent sets were judged largely by the sensory form; as the work progressed it became increasingly conscious. The different series as a whole show a growth in consciousness and *pari passu* of one's unfitness to serve as subject for such experiments as the present. We knew too much to be fit, although we worked exceedingly hard toward the end; the effort, probably, was what spoiled the work.

Because of our desire to be as free from bias as possible, we refrained in our conferences from the discussion of our introspective tendencies. For this reason exact comparisons of individual series

is impossible. But inspection of the tables, especially of No. 7, shows that one effect of voluntary attention is a falling off of the number of correct answers to the side or stimulus previously favored, and generally a marked increase to the side or stimulus before at a disadvantage. The result is, in part at least, due to interference with a physiological bias, and is accompanied by a change in the method of judging. Attention, when stimuli are to same sense, decreases the probability of correct answers; when to disparate senses, increases the probability.

14. PERCENTAGE OF CORRECT RESPONSES WHEN STIMULI ARE TO

SUBJECT.	SAME SENSE.[1]						DISPARATE SENSES.					
	Indifferent Att.			Directed Attention.			Indifferent Att.			Directed Attention.		
	Right.	Left.	Av.	Right.	Left.	Av.	Click.	Shock.	Av.	Click.	Shock.	Av.
S.	95	80	82	72	62	67	51	91	71	74	82	73
D.	78	70	74	80	63	71	19	98	59	61	87	74

This table must be taken with the following, which shows the

15. NUMBER OF TIMES WHEN JUDGMENT OF ORDER

COINCIDED WITH DIRECTION OF ATTENT'N.								WAS OPPOSITE THE ATTENTION.							
Whole number cases.	Subject.	Clicks. Correct.	Shocks. Correct.	Crossed hands.[2] Correct.	Average of the three series.	Click and shock. Correct.		Subject.	Clicks. Correct.	Shocks. Correct.	Crossed hands.[2] Correct.	Average of the three series.	Click and shock. Correct.	Whole number of cases.	
466	D.	56-82	205-64	69-57	66	136-88		D.	104-65	195-71	11-56	68	284-67	594	
	S.	83-54	206-75			188-82		S.	77-73	194-59			210-77		

A little more than a fourth oftener, the judgments went counter to the direction of attention, though there was a slightly greater number of correct answers with than against—72% and 68% respectively. But with such results it is in place to ask, what are the results of voluntary attention? They are complex. (1) There is a general tendency to throw doubtful cases in the direction of the attention. In numbers of places the introspective note added to the subject's order-record is, "Uncertain; go with attention." (Unless there was good reason, objective or subjective, for the rejection of a trial, it was checked, even though

[1] Sum of click and of shock series.
[2] See p. 550. First number of each couplet gives the "number of times"; second number, the per cent. of correct answers.

the order-judgment was obscure; else should we never have finished a set after our critical mood was well seated.) Yet doubtful cases were little if any more prevalent in the state called "directed" than in that called "indifferent;"—as shown by Table 12, the number of "sure" answers is but three per cent. greater in the latter. The notes of S. lead him to infer that high grade, *i e.*, very well concentrated, attention, tends to draw the judgment with it; his figures are as follows, for the click-shock series only:

16.

High Grade of Attention.				Low Grade of Attention.			
Shock First.		Click First.		Shock First.		Click First.	
Att. Shock.	Att. Click.	Att. Shock.	Att. Click.	Att. Shock.	Att. Click.	Att. Shock.	Att. Click.
29-100	27-67	17-59	36-89	65-89	79-84	89-79	58-60

Yet, as has been so often said, our record was a growing one, expanded as difficulties arose; hence it does not extend alike to all the series. What we should have passed as unquestioned good attention at one time, a month later would be found seamy. D.'s record, so far as available, for cases when the attention was felt to be good and the order of judgment was with the attention, shows 93% of correct answers as against 74% correct when judgments went counter good attention. (These are from cases listed in Table 15, and are characterized by a good degree of concentration. They differ from the cases recorded in Table 12, also, in that those have reference to certainty of judgment.) At first the record seems to make good a claim that attention is an aid, but comparison with the "Distracted Attention" series—Table 12—shows another 93% got under conditions the opposite of attentive.

(2) The most marked subjective effect of directed attention, for D. at least, was the weakening of the stimuli. Ordinary attention to a stimulus is usually accompanied by an increase in the relative prominence of the latter in consciousness,—for simplicity, say its intensity; (we will leave aside any reference to, *e. g.*, dreaded danger which vanishes when bravely met). When the stimuli, clicks or shocks, were tested, preliminary to the regular series, to ensure likeness, they were easily compared and equalized. Then, as the experimenting went on, it became increasingly difficult to sense them, especially the faint ones. This loss was not due to fatigue, *i. e.*, to exhaustion of the part concerned, because a return to the test-attitude of mind revived the stimuli. That it was the result of an attention-strain seems evident from a study of the growth of the introspection notes. In the early part of the work, stops to overhaul the apparatus with the intent to find in it an objective cause for intensity-variations, were frequent; but when fairly in on the shock series, we found that to throw the attention well into a hand was equivalent to diminishing the intensity of the stimulus to that hand. Not that this result always came, for there are several comments of surprise at pairs that came equal or even with intensities the reverse of that noted above. When we reached the click-shock series, the influence of attention was very marked. The

indifferent series indicates an almost complete subjection to the shock; but when attention was given the hand, the shock-stimulus was usually weakened, and at times to so great an extent as to leave room for doubt whether it had really been sensed or only expected. The only series from which can be taken individual cases specifically noted, is the click-shock one, as follows:

17. TIMES WHEN ORDER WENT

SUBJECT.	WITH ATTENTION AND		AGAINST THE ATTENTION AND	
	With Faint.	With Strong.	With Faint.	With Strong.
D.	32	5	17	91

In this click-shock series the case for S. when the shock leads, is like that in the shock series (Table 5),and when the click leads, like that in the click series (Table 1). That is, in the former the number of correct answers and the direction of attention go together; in the latter they separate. The same is true for Miss Hamlin (in unpublished tables), but not for D., who varied his attitude often, but held to the original bias of faint intensity and priority. Because of this bias to "faint, therefore first" (p 545), a likeness marked as most appropriate suggested itself to Cinderella,—quiet before her assertive rivals, yet recognized finally, by her quality, as the true leader. Probably the comparison is only an elaboration of the struggle present from the outset, between a "feeling" and a "time" order, *i. e.*, faint and strong intensity.

The occurrence of the ghost-like after-image of the shock which persisted in the hand until it was given notice, though the original shock had been ignored, marks for introspection a difference between the so-called inner and outer forms of attention, — because the after-image (and oversight of its original) was most common when attention was most strongly concentrated on the hand. So far as inner attention is concerned, the appended table shows that with D. the judgment goes with the direction of attention. When stimulus and attention are on the right side (left hand), or *vice versa*, by making many wrong answers for the opposite side, the subject raises the number of correct answers *with* attention, to a good figure. But the particular difficulty found in this series lay in the location of the shocks, a feature that comes out more markedly in the trials with indifferent attention. In order to get 137 answers to a R. first series, there were given 285 trials; to get 144 answers to a L. first series, were given 247 trials. The shocks would not remain in the hands, but they gravitated to or toward the median plane. At times their fusion was complete on the Cyclopean eye order; very often it was partial, as when the right-side shock remained in place whilst the left-side shock approached it more or less.

18. "Crossed Hands" Series.

Subject.	Indifferent Attention.						Directed Attention.									
	R. First.			L. First.			Right First.					Left First.				
	a	Ans.	b	a	Ans.	b	a	I	b	II	b	a	I	b	II	b
D.	285	137	89	247	144	67	50	26	20	24	5	47	23	1	24	19

a, Number of trials; *Ans.*, number of answers; *b*, correct answers; I, attention to right; II, attention to left.

Of the cases of total disappearance of stimulus there were on the right side (*i. e.*, from left hand), forty-two; from the left side (right hand), sixty-six. Twenty-one of these disappearances came in groups of three or more; the remainder were scattered or in couplets. The total loss of one stimulus is probably the extreme of translocation. The illusion is probably due to the fact the median plane is the most favorable region for sensory focus; here, or in right-handed people when confused a little to the right of it, would be projected ordinary stimuli sensed under unusual conditions.

In general it may be said of this section of our experiments that voluntary attention aids one to break up the course of his normal errors, or constant bias (cf. Tables 4 and 13). Aid is got by attending to the weaker stimulus of a pair given to disparate senses (cf. Table 7), because so to do is to inhibit in some degree the response to the stronger. It does not follow that results will be bettered by this attention; that can be seen only when the entailed disturbance ceases and action becomes again uniformly adjusted. For example, in the single-sense series "inner and outer" attention were normally balanced and the judgments were fairly correct. But in the disparate-senses series it was necessary—to attain an aim—to shake off the dominance of the shock; any means to do so would have the result got—of equalizing the number of answers for the two senses. In this way is it that attention is so effective in producing illusions, inverting time-order and the like, because the process set up by its interference is unlike the ordinary procedure it disturbs. Manifestly, attention may confuse as well as make clear. The disturbing effect of attention's strain to be inferred from the tables given, is confirmed by two side series carried on with Mr. G. W. A. Luckey, using medium and faint (*i. e.*, just perceptible) clicks, R. and L. leading in irregular alternation. The subject aimed to hold himself "alertly indifferent" throughout the series.

19.

Medium.		Faint.	
Number Given.	Per Cent. Correct.	Number Given.	Per Cent. Correct.
500	83	460	76

To get the faint clicks it was necessary for him to tense to a high degree, and this effort brought on a fatigue of "indifference" which was fully as exhausting as one from great "concentration." As the muscles of response tired (from whatever cause), the consciousness dulled. In connection herewith may be inserted a statement of the whole number of correct answers given by S. and D. in all the series under discussion.

20.

Subject.	Indifferent Attention.	Directed Attention.
	Per Cent. Correct.	Per Cent. Correct.
S.	70	70
D.	76	69

If we extend our survey to the three sections under which our experiments were conducted, it is safe to make the following statements:

1. Attention is an aid in those reaction-time experiments in which the aim is to reproduce a given series—be it muscular or associational,—because in these the general conditions, as well as the especial incidents which a subject soon comes to make use of, serve to give cues. Thus one is enabled to "perceive the probable," and the expedited reproduction of the anticipated response at times leads to the *vorzeitige* reaction.

2. Attention may or may not aid in association, or rather, in the recall of associations, when we take note only of quantity. When regard is given for the presence of familiar associations, such as would be expected to appear first in ordinary stages of attention, the attention strain proves a hindrance.

3. Active attention is a positive detriment in new work whose cases must be decided each for itself. The kernel of active attention is prevision, and always prevision of an act. If the strain be great enough, instead of facilitating perception, it weakens the intensity of the first stimulus and thereby makes it other than what we await.

We may go further and characterize as disadvantageous attention when applied to the details of any work, in so far as regard is had for quick and correct execution; for acts that can be done quickly are habitual,—any interference with them, by means of attention, is in its very nature the putting of undue stress (or tension) on one link. In brief, attention is an aid to speed and surety only when and in so far as the conditions are the reproduction of a known series, *i. e.*, the reinstatement of the probable; and it is thus helpful only when the conditions converge on the few possibilities that are to be given. Active attention aids in attaining new conceptions by interfering with a habit series, thus making possible a change in direction of discharge. Passive attention aids by suspending actions that if under way are possible diversions, thus giving the stimulus a clear road to follow in the most habitual mode. The two are phases of every act, and are meaningless apart; nor can one be sure, in strange conditions, if his attention effort will be profitable or the reverse.

II.

Before continuing further the discussion of observations made whilst carrying out these experiments, it will be well to review briefly the problems of attention as these are now formulated. For the present purpose it is advisable to restrict our historical survey to the empirical psychologists, and of these to begin with Condillac, because of his elaborate theory.

Fancy a statue, says Condillac, built within on the plan of a human body, but with all inlets (senses) closed, and under the control of a master who opens them at pleasure. The statue is in every respect like a man, save it is absolutely devoid of ideas. By manipulation of the sensations ideas are built up, for judgment, reflection, desires, passions, etc., are only sensations which transform themselves differently (1-pp. 39, 40). The first sense opened is smell. The statue, modified by contact with an odor, knows a new state, though what this is, in our terms is unknown. With this sensation and the knowledge of it, appears also attention; to sense, know and attend to are one and the same. Henceforward experiences are attended by pleasure and pain (1-pp. 44, 45). In an analysis of the faculties of the mind, Condillac distinguishes between a general view of a landscape and a discernment of a particular object in the scene. This look, by which the eye tends to the object on which it is directed, is an action; for this reason it is called attention; this direction of the organ is the only part the body has in attention. On the part of the mind, attention is one sensation, experienced as though it were the only one, *i. e.*, it is an exclusive sensation. Comparison is a double attention (2-pp. 363, 364). To return to the statue: The odor which the statue senses does not vanish so soon as its source ceases to act on the nose. The attention given it retains it, *i. e.*, there remains an impress more or less strong, in accord with the degree of attention. Behold the memory! (1-pp. 48, 49) Possessed with a memory, the statue is a person, though all his psychic life is expressed in terms of smell (1-p. 89); this individuality is shown in the use of the personal pronoun. Why does the statue say I? Because we think only in words. Language is expression, and the elements of the language of action are innate (2-pp. 401, 402). Since the mind can never get away from sensation (1-p. 3), the work of reason is to clear up what was implicit in former experience. For, while the first sensation-contact does not produce a full idea, subsequent ones do so, and these, he assumes, know as we know them (1-p. 89). Evidently Condillac confuses contact, sensation and perception, and by piling up many of the first, believes himself able to produce the last. Looking as he did for all plus to come from without, he puts attention at the gate, and sees its presence in the action, as shown in the adaptation of the sense-organ that conditions the reception of an impression. This readiness is an integral part of the sensation, and the more exclusive the sensation, of necessity, by definition, the greater the attention.

It is easy to cross-question Condillac into confusion. If the statue knows its new state, why should it not know its former condition, prior to all sensation? Evidently the "I" that marks the advent of personality is not a smell term. His explanation of the origin of memory is rank tautology. Yet he helped set the trend of interest in mind-study toward the expression side, and experimentation, while it has made ground for the science of psychology, has also helped to make clear the unsoundness of some of the earlier assumptions.

Speaking broadly, we may say those who yet hold views on attention like Condillac's, know little of experiments; for them there is no need to demonstrate psychic power.[1] This point should be kept in mind, for too commonly it is assumed that experimental psychologists are not psychologists at all, but physicists who are anxious to reduce all life to terms of motion. But the distinction felt by Condillac, between consciousness and its content, though blurred in his words, is quite as real as is the intimate body-mind connection he noted, and these two phases are inseparable in any full study. At first the experiments in psychology were scattering. Bessell's solution in 1822 of the personal equation, Helmholtz's measurement of rate of transmission of an impulse through a nerve, 1850, Fechner's "Psycho-Physik," 1860, and, finally, Donder's work in 1861, are matters that serve to show how the problem of attention, as a subject for experiment, gradually came to the fore. Fechner was a pretty thorough-going advocate of the Attention-is-in-the muscles theory, and from the appearance of the Psycho-Physik there was much work done in German psychology which involved the use of attention. "Since the suggestive dissertation of Herbart in 1822 *(De Attentionis mensura causisque primaris)*, attention has come to play a very important rôle with psychologists, with whom it has had much to do in undermining the theory of faculties, until, as is known, with Wundt it may be called the central psychic category."[2] In 1873 Exner published his *Experimentelle Untersuchung der Einfachsten Psychischen Processe*, in which great stress is laid on attention. Besides the studies of Helmholtz, there appeared within the space of a few years the advance guard of the host of modern psychologies: Delbœuf, 1872; Hering, 1861-75; Brentano, 1874; and in 1874 Wundt's first edition.

Wundt's aim was to make psychology explicative, and for this purpose he made use of measurement. He starts from the psychic side, and his interest is chiefly in the unification of experience, his "Apperception." "One might say the last great step in Psychology was taken when Wundt pointed out the incompleteness of the English Association theory," says Lange (p. 395). To Wundt the natural expansion of the unitary nature of mind constitutes reason, and by definition of its nature, precludes the possibility of thinking more than one thought at a time. His psychology rests on this, that there is a physiological, or unconscious, basis for sensation; once given sensations, *i. e.*, psychic facts, and reasoning is inevitable. The impression I get is that Wundt makes little of the "unconscious" as a field of study. He calls the muscular form of reaction a pure reflex, destitute of any psychic worth (1, II p. 310), and though he hopes we may learn more of the "physical dispositions" left by sensations, he doubts if their study can throw light on the origin of the "psychic dispositions" (4th ed. II, 265). In the first edition (4th Abschnitt, 18th Capitel) he holds that the elements which are yet without (on the nascent side of) consciousness do not have a unity. Despite the fact that ideas seem to pop into consciousness fully formed, their unity is given them by consciousness only. Wundt is not one who believes in a stream of thought; the break between the apperception of *A* and that of *B*, he says, is due to the fact the mind must turn from *A* to *B*; and again, our perception of time is due to the nature of apperception,—the mind must go in jumps (4th ed. II, 429f.). In the first edition (p. 717) we read: "Because in the synthesis of feelings *(Empfindungen)* and in

[1] *Vide* Spencer's "Inadequacy of Natural Selection," *Pop. Sci. Mo.*, XLII, p. 801, n.
[2] G. Stanley Hall, *Mind*, 1883, p. 177.

the association of ideas *(Vorstellungen)* consciousness comprehends itself as active, that outering of it arises which we call attention. Manifestly in any moment consciousness has not made equally prominent all the inter-relations of ideas, but has turned almost exclusively to a few. This feature may with advantage be compared with the action of the eye, and the focusing of consciousness be called inner sight." At this time, it seems, Wundt's ideas were simple; attention was the expression (in muscles) of the working of consciousness. But the fourth edition reveals how little importance he attaches to expression, and how fully he is under the spell of his *Blickpunkt* figure. Just how many and what parts of the process whereby sensations are received and elaborated are physiological—according to his theory,—Wundt does not make clear; but to him, now, attention is a feeling which accompanies psychic activity, and feelings thus far are treated by psychologists in a cursory fashion—in lump. This activity which underlies is apperception, a strictly psychological fact, and to it Wundt devotes his study; the physiological accompaniments, so called, get little of his notice. Sufficient for him is it that apperception and not the intensity and *quality* of a stimulus determines the line of sight (I, II, 121). Consciousness is a *Blickfeld*. Wundt assumed his inner force, and busied himself with experiments to determine how rapidly it could act under certain factitious conditions. His consciousness is closely held to his inner *fovea*, and to use his own expression, what exists outside the circle of clearest vision, is ignored; of ideas outside clear consciousness we can say nothing, save historically.

Coincident with Wundt's first edition is G. E. Müller's *Zur Theorie der sinnlichen Aufmerksamkeit*, a study which emphasizes the difference between outer and inner attention, and finds the former to be dependent on the latter. Dualistic interaction must, on rational grounds, be possible (p. 3). Not the objective intensity of the stimulus-effect, but the perception, is increased by attention (p. 4). Sense-attention is the reinstatement of certain conditions of the sense-organs (p. 50). If nerve-cells can act on mind, then mind can act on nerve-cells; since mind can act on motor nerves, it is reasonable to suppose it can act on sensory nerves (p. 3). Images or vibrations travel down sensory nerves and modify incoming sensations (pp. 86, 87). A mental state in possession of the field can bar out rivals. In voluntary sense-attention the mind consciously gives the desired adjustment to the sense-organs; but objects have the power to suggest the same adjustment which is made involuntarily by the mind (p. 110). These extracts serve to give fairly well the general standpoint of the Leipzig school. Sense-attention is a minor matter to psychologists, and is dependent on inner initiative.

In 1888 Nicolai Lange published his *Beiträge zur Theorie der sinnlichen Aufmerksamkeit und der activen Apperception*, in which he more definitely stated the subordinate value of sense-attention. Were it not for the mental power to attend to faint impressions and to ideas, our minds would be open to all the blasts of experience; in which case even the sense-impressions themselves would have no meaning, because of no interpreter at the center (p. 391). Active attention consists in intensifying one idea-complex by the aid of another; it acts after ideas are in the mind. For long no other explanation was given why attention flickers than: it is the nature of apperception so to do. It was said the fixated idea was held by an act of will; or, that opposing ideas were inhibited. Lange passed by these reasons, and endeavored by experiment to show the variations were due to the coming and going in the mind of images of the fixated stimulus. Sense-attention, then, consists

in the assimilation of a sensation by its corresponding memory image which has been actively recalled. These images can be recovered actively only by means of voluntary innervation or movement impulses which are associated with them. This process we call active apperception. The variations in active apperception are conditioned by the general relativity of psychic phenomena, and form the cause of all other periodicities in consciousness, such as are expressed by sense-attention in the time-sense and in the periodic phenomena of memory (pp. 421-422). This theory of sense-attention (which Wundt adopts), demanding an inner image, to which the sensation is assimilated, is the old problem of perception, and reminds one of Parmenides' "Like is known by like." Probably in Wundt's mind the resemblance is only superficial; but I find it hard to get Wundt's position clearly.

Ludwig Lange, in the same volume of the *Studien* (IV, pp. 479-510) published a report of his *Neue Experimente über den Vorgang der einfachen Reaction auf Sinneseindrücke*, wherein he noted two very distinct methods of reaction — the muscular and the sensorial. These are too well known (in words) to require description. Wundt adopted the conclusions of the Langes. The work of the one gave him a criterion whereby to reject all experimental study in psychology which does not proceed on the Wundtian lines; that of the other furnishes reinforcement to his apperception-centre theory. The Langes, in harmony with their teacher's position, consistently refuse to extend their study as *experimental psychologists* into the field of "the unconscious," or the physiological.

It is not my wish to exploit the controversies that have arisen over Wundt's theses,—some of which are bitter. The opposing camps are separated more by innate tendencies or philosophical bias than by differences of fact. Some men by nature cling fast to the tangible. It is easy to say they take short-sighted views, and give but partial accounts of the problems they investigate; they grant the truth of the charge, and try to remove it by discovering more. Their results are but fragments; we need not look to them for complete theories. Two of these it will suffice to mention.

In 1889 appeared Ribot's *Psychologie de l'Attention*, comparable in its general method of treatment, critical, with Müller's *Zur Theorie der sinnlichen Aufmerksamkeit*. Müller's great interest centred on the psychic initiative, Ribot's on the mechanism of attention. Ribot recognizes the subjective aspect of psychic phenomena and asks, what are its bodily conditions? These he finds in the more or less isolated (differentiated) muscular tensions, which in turn call into action limited portions of the nervous system. The ordinary round of life exercises the brain normally, that is to say, all parts function in an habitual way; new conditions disturb this equilibrium and the new tensions arouse new cerebral arrangements, and thus produce the states *known* as spontaneous (natural) or voluntary (artificial) attention.

But it is to Münsterberg we must turn for experimental investigation of the motor basis of attention. Much has been made of the antagonism between the views of Münsterberg and those of Wundt, yet, as has been said, the difference rests more on innate bias and method than on fact. To one attention is a feeling, to the other it includes the activity behind the feeling. After Wundt adopted the conclusions of the two Langes, the whole Leipzig school felt obligated to close one portion of the field to experiment; whereas Münsterberg, believing there is a province of psychological *phenomena*, set himself to trace these phenomena. Münsterberg maintains the distinctively psychological feature of this study, but sees

no reason to halt so long as there are "physiological" facts with psychological meaning. The results of the Langes gave points of attack, and in the following year (1889) appeared Münsterberg's *Beiträge*, I and II. In the first are set two problems. (1) May not the psychic results reached by voluntarily exerted *Vorstellungsbewegungen* be got without the conscious use of will? (2) Is it possible, by studying judgments whose premises are variable, to find the spot in the psychic mechanism that concerns the transition from passive to active *Vorstellungsbewegungen*? (1-pp. 67-68.) "To him who endeavors to so set forth the psychophysical theory that all the phenomena of consciousness can be referred to changes in the physically conditioned contents of consciousness, no greater bar to progress exists than the distinction between the field of non-voluntary association and that of voluntary *Vorstellungsbewegungen*" (p. 64). The sensory form of reaction requires more time, say Lange and Wundt, because it includes the times needed for perception, apperception, volition and innervation; the muscular form is a mere physiological reflex. The former is open to great variation in time, but has a sure outcome; the latter is uniform in time, but liable to error. Can I get results qualitatively sensory, and which (per theory) are attainable only by the sensory form of reaction, by using the muscular form? asked Münsterberg. He did. The judgments given (as results in his experiments) are such as ordinarily require reflection and choice; the times correspond to the motor requirements.[1] Manifestly, "of any sequence of the various acts we cannot speak; yet with this sequence stands or falls the apperception theory" (p. 121). Ordinary consciousness distinguishes voluntary and involuntary mental acts, and is supported by the prevalent psychological school, as represented by Wundt, which sharply separates apperception and association, denies the former is derived from the latter, and affirms that choice and judgment are not influenced by the contents of consciousness, but are basal. The apperception theory is safe so long as it remains within the psychic sphere. But when we think of the brain and the result of physical changes there on the content of consciousness, we see the two are not separate; physical dependence must be related to physical causation (cf. pp. 107-108). Even though the short form be as Wundt says, a mere reflex, yet "I believe it is competent to form a point of departure for the investigation of complicated psychic acts" (p. 110). In cases of pure apperception the time should be shortest, according to Wundt, when attention is on the first member of the series, the signal; Münsterberg found it to be shortest, in the sensory form, when attention was on the last member, the movement (p. 114, 115). If, one may ask, both reaction forms have psychic worth, how account for their differences? Münsterberg's reply is, most of the work is done, in the motor form, before the measured part of the experiment begins (p. 171). When the conditions are known and the order is to react quickly,

[1]The work, in brief, is as follows: With a five-fingered keyboard and five classes or possibilities of answers, the subject makes in the shortest time a finger movement to express a reply to a problem given by the operator. *E. g.*: In the seventh series of experiments, with fingers assigned to groups: Poets, Musicians, Naturalists, Philosophers, Statesmen, a name—*e. g.*, Locke—was to be listed under the heading Philosophers. In this series the average time taken when the sensory reaction was used, was 1122σ; with the muscular form, but 437σ. The second part of the work was given to a comparison of free association with acts of simple judgment. Beginning with random association the experiment was conditioned, both subjectively and objectively, until complicated judgments were called for, yet the reaction-times did not increase in like ratio so long as the short form was used.

the will to act already exists in the idea when perceived. Thus it is the reaction is made before the signal has roused what we call "its meaning" in the mind, before it is apperceived, and before any relation between it and the reaction has found a verbal judgment (p. 166).

Part II of the *Beiträge* contains an article, *Schwankungen der Aufmerksamkeit*, wherein is detailed a re-examination of the work on which N. Lange based his theory of inner initiative for sense attention. Wundt's first care is to preserve the unity of consciousness, Münsterberg's is to preserve psychophysics. If we say consciousness can turn away from one part of its content to another, like the physical eye, then psychophysics is at an end (pp. 70-71 and 123). The outcome of this study is that the contents of consciousness and not consciousness itself, change with the variations of attention, and that these variations are due to peripheral causes (*e. g.*, muscle fatigue) and not to presence or absence of an inner assimilating memory image. "I believe my experiments point to that conclusion which Lange rejected, namely: these variations are conditioned peripherally and not centrally. Understand me; I do not say that attention in general is only a peripheral phenomenon, nor that all variations in the content of our consciousness find their psychophysical cause outside the central organs; I do not say that alterations of our special cases run on unconnected with central reflex paths, but I believe that this particular effect, the coming and going of the perception, is due to changes within the sphere of the contributing sense organs" (p. 94). In *Die Association successiven Vorstellungen* Münsterberg (3) describes a study of the question: Is the reproduction of ideas determined by an inner relationship alone, or must there be an outer link, arising from the simultaneity or sequence of the stimuli? He decides for the latter, and holds that idea *a* dissolves itself in the innervation that makes the tension which calls up *b*. It lies in the nature of the muscular system to associate its movements serially on reflex lines; hence one movement is the stimulus for its successor. The various stages of this series are reflected—in consciousness—as associated ideas. Münsterberg employed the memory-span test, using letters seen singly. His first group was made with free attention; the second group was with attention distracted by mental arithmetical problems performed aloud. In the latter group his ability to reproduce the series was much diminished because the vocal apparatus was so employed as to prevent utterance of the names of the letters seen.

The fight is still on. Each side believes in a psychic force—the motive power; each believes objects can arouse this force. The one takes the mind after it knows what it does and says that all which goes before is inscrutable to psychology (but cf. Wundt, 1-II, p. 279); the other trenches on this preserve, and sees in the connection of feeling and muscle tensions a preliminary stage in the formation of ideas which is fairly safe matter for the psychologist's study. It may be said the efforts of the one are on Kantian lines to push "understanding" back into the territory of sense (cf. Wundt's innervation theory, and passive apperception); of the other, to advance "mere association," brain processes and muscle tensions, into the field of mind. In Vol. VIII, *Philosophische Studien*, are articles by Eckener and Pace, based on re-examinations of the contradictory experiments of N. Lange and Münsterberg, which claim to substantiate Lange's conclusions. The matter reminds us of the claims made for the innervation theory. The latter was plausible, but when, after long dodging it did give tangible

"proof," this became aid to its opponents. The conclusions of those who defend the inner initiative must always rest on inference; their proofs when brought into the field of action become Pyrrhic elephants.

III.

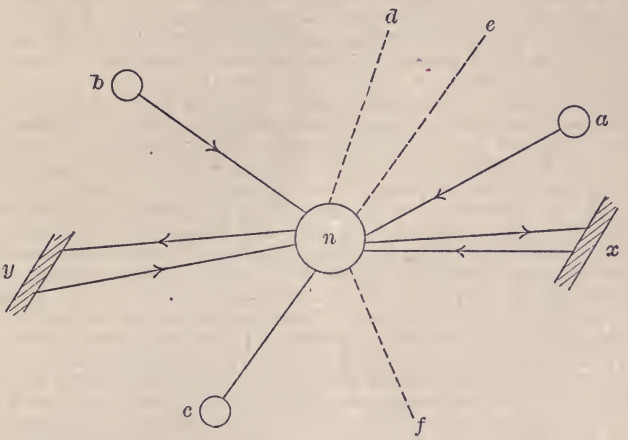
After one has been working in a given field for some, time there grows up in his mind an almost unconscious attitude toward the subject of his study,—the result of his reading and experience. It is hard to describe this position simply, because in its darker parts there lie all the explanation and harmonization one needs; these are felt to be there, even if not evident to a critic. Yet some clue to a writer's bias is helpful; hence the following statement of the thesis maintained in this paper, given with the hope the argument will be examined to learn the meaning put into the words used.

A popular psychological assumption is that mind is awakened by stimuli from without,—the production of sensations. This view may be put thus: *S* O———o *s*, in which *S* represents the central system, *s* a sense organ. A stimulus in *s* passes to *S*, and there is known. From *S* in turn the stimulus-force, or idea-force as it should now be called, passes out to other parts of the organism. Whether it passes on motor nerves only, is in dispute. G. E. Müller, resting on Helmholtz's experiments, claims an idea can and does retrace the sensory path and awaken in the end-organ sensation. Wundt, James, and most psychologists hold that consciousness is an inner force that expends itself at will—on motor lines; Bain makes much of inner spontaneity plus fortuitous combinations of desires and movements, which enable the mind to satisfy its wants. Wundt, James, Müller and others hold to inner association and arrangement of ideas. Opposed to them are Bain, Münsterberg, Ribot, Féré, who hold to muscular successions that condition association. The former teach that consciousness precedes and directs attention; the latter claim it follows the muscle tensions that are "attention." The position most in accord with the common understanding of our subject is that held by the men of the inner initiative. *E. g.*, for Prof. James "selective attention" gives us what we call sensations, *i. e.*, picks out certain vibrations and arranges them in the order in which they come to consciousness; Wundt's apperception theory is akin. This mobile inner force can so deploy its energy as to facilitate sensation by preparing the end-organs for the reception of stimuli, and even, as some claim, by anticipating in the sensory nerves the stimulation; it also helps us to perceive, conceive, discriminate and remember; it gives us time-order and ideas of number; it quickens reactions; it both magnifies and suppresses feelings and ideas; it interferes with our bodily functions. But experience shows us that attention is not always controlled from within, and to meet the need names are given, *e. g.*, reflex and conscious, involuntary and voluntary, and passive and active, whereby it is hoped the attention forms may be classified. Here again disagreement prevails; to the strenuous advocates of an inner force a self-directed activity can be neither reflex nor involuntary. Wundt, in the fourth edition (I, II p. 278), lapses somewhat, gives up the terms voluntary and involuntary, and claims that attention is characterized by passive and active features, and that the former always precedes the latter. This inner-activity view is one that as a whole lends itself to easy comprehension; only when its bases are touched does it disclose gaps. Against it are several theories. Spencer treats the mind from a totally different stand-

point, and so ignores attention; to Ward it is one of the fundamental divisions of mind. Yet another position, and one that in some respects meets with favor because of its tangible reference, is that attention considered on its psychic side is only a state corresponding to a physiological state of activity in the muscles. The advocates of this view—to speak in a general way—are Bain, Münsterberg, Ribot, Féré. No two of these men agree throughout, yet for general purposes the classification may stand.

The remainder of this section will be given to an attempt to formulate a working hypothesis of a view that sees in attention *per se* a muscular basis. The effort will be to apply in another way what has been in the air so long as to be general property; *e. g.*, Hall's insistence on motion as the basal psychic fact, James' emotion theory, Münsterberg's muscle-link for association, and the many minor studies akin to Lehmann's.

The annexed figure may illustrate the process wherein ideas are made manifest.



a b c are sense organs; *n* is the central nervous system; *x* a muscle group whose tension proves favorable to use of *a*; *y*, muscle group that becomes connected with *b*; *d e f*, other muscle groups, some or all of which may, and at times do, tense simultaneously with *x* or *y*, or both.

Assume the discharge into *x* is definite. Then my thesis is: When the stimulus comes via *a*, it must end in *x* before consciousness can be said to exist. The process *a-n-x* is an indecomposable unit which corresponds to the single state of consciousness that knows (or is known as) the given sensation. *a n x* gives the sensation-tone, the qualitative characteristic of the particular experience; but, alone, it is in no general sense of the word to be considered as "known." *a n x* is the condition of a bare sensation (in so far as such an abstraction can be considered); the conditions of knowing *a-n-x* are the related tensions in *y-d-f*. But the discharge from *n* is seldom if ever exclusively into *x*, though it is assumed the greater part is so sent; instead it irradiates and sets up a general readjustment, into which comes a new disturbing factor in the incoming sensation from the tension of *x*. This latter state, *i. e.*, the reception and assimilation of *x*'s tension-sensation, gives us knowledge about the former *a-n-x*

state. *a-n-x* gives a simple idea; if it can be said to be known at all, it is absolutely relationless; no attention can be given it until its final term has been referred back to *n* and redistributed. Thus comes the claim that attention, as a psychic fact, follows and depends on the muscle tension, and we do not attend to an idea until after the idea-stimulus has run its course. The links that connect our ideas and bring them into the field of consciousness are these kinæsthetic sensations, and our personal power is shown in rejecting some and holding to others. As our bodies could go nowhere save for bone resistance, so our mind's endeavors would be fruitless without muscle objectification. It may be the stimulus that reaches *n* is of a kind or degree that has no preferred outlet; in this case the many and inharmonious tensions produce a state of emotion, *e. g.*, fear, with beating heart, panting breath, protruding eyes. Normally, however, one path does get preëminence, and the sensation gets a relatively definite name or expression—in vocal cords, facial muscles, a shudder, or otherwise. Theoretically it was at first a matter of indifference whether *a-n* ended in *x* or in *y*; practically, with bodies constructed as are ours, some lines of discharge are innate. Yet connections may be and are made between, *e. g.*, *b* and *x*, *a* and *y*. Thus names call up not their own "ideas," but their "meanings."

The correlation of tensions is one aspect of a process of which the other is the unification of ideas. This is shown in the acquirement of an art, *e. g.*, writing, cycling. At first are many unneeded and untimely efforts and much confusion as to one's course; with practice the irrelevant acts are suppressed and their force turned into desired channels. In this correlating process, so long as there is a prospect (or feeling) of success, the subject is interested; when failure is inevitable, interest goes. Herein is a clue to the nature or origin of interest; interest is the inner aspect of the muscle-correlation process. Interest attests a nascent adjustment of actions, and roots in the unconscious because at bottom the muscular harmonization is physiological. Interest, however, is never present in first sensations, because it partakes of and follows the intellectual element. First experiences awaken in us emotions, *i. e.*, states corresponding to first or incomplete tensions and tension-adjustments. Emotion lacks clearness because it has no definite or dominant tension to tie it to the objective, and an emotion is difficult to reproduce because it lacks a special muscle element. Given the motor means of recall, and interest appears as an index of the smoothness (or possibility) of interaction of various ideas and their tension-elements. To this extent interest and attention are running-mates.

To the claim that attention can be present only after the idea that evokes it, the objection may be made that a babe is all attention to every intense sensation. But the babe's ideas get their set by these very tensions, and grow in clearness as the tensions pass from mass to particular; unbroken attention is equivalent to catalepsy. The state exemplified in the babe is what I understand Wundt now to assert in his statement, "passive precedes active attention." Further, the stimulus passes to its reaction, the latter sets up an idea in mind; then—with one idea uppermost—comes will (James) or voluntary attention, *i. e.*, knowledge of what has been done, and prevision of a repetition under like circumstances. Yet this idea that is in mind is but a representative of the act to which interest attaches and for the sake of which we wish to attend. By conforming to it, we put ourselves in condition to get a repetition of the former stimulus and its results. How conform? By tensing one

and another muscle until we are aware of the correct mental state. The assertion: The presence of an idea before an act constitutes ac- active (or voluntary) attention, seems negatived when we consider the running-off of a habit-chain in which each step is preceded by its non-willed cue. In fact no sharp line can be drawn between passive and active,—it is a matter of the degree of tensions involved (cf. Münsterberg, 1, I, p. 67); to the actor the distinction is known by a wider grasp of related acts, which calls into play the higher centres, not necessarily to control, yet in action to accompany the habit-centres. We can attend to but one thing at a time, because to us, in our stage of growth, anything short of a unification of tensions produces a greater or less degree of emotion, wherein the harmonization of tensions and mental state are alike deficient, and one knows not what to think. As a matter of fact we can attend to two or more matters that do not interfere in the modes of expression, though here as in any other concatenated act, now one, now another part of what is really one compound act is clear in mind. Yet this differs in no essential respect from any art.

When any part of the body is the object of attention we know we attend to it by experiencing the tension of its muscles, our attention is assured by the strain. When a sense is used as a medium of attention to a stimulus, the strain becomes of minor consideration—necessary to certify the mind is rightly directed, yet of value only as a basis of comparison with the change induced by the awaited stimulus. The difference between active and passive attention, as these terms are commonly used, is that in the former the body-mind complex is in a condition favorable to the recognition of likeness or difference of in-coming stimuli; in the latter comparison is difficult, for either of two reasons: (a) general state of relaxation, (b) great tension of a part not directly concerned in the reception of the unexpected stimulus,—for in either case diffusion is hampered and meaning tarries. Yet comparison may not be difficult in passive attention if so be the stimuli are intense or much unlike, for under these circumstances either the force is sufficient to overbear resistance, or the unlike stimuli find outlet in free channels. The mind feels its freedom when it passes gradually from one object of regard to another, and does not when it goes by leaps, as though a creature of caprice; so we call the gradual progress "active," and feel an inner power, fore-seeing, hence called "voluntary."

Extreme concentration of attention, considered as an inner activity, defeats its aim in that the tension-process becomes greater than that which normally accompanies the awaited stimulus, and thus a disturbance is set up whose outcome is to fill the mind with an irrelevant strain to the exclusion of the one that belongs with the stimulus. Attention (and here tension is meant) needs mostly to be in other parts than those that mediate the stimulus, for thus all interfering action is checked and the parts concerned are free to adjust when aroused. Nor does this apply only to sensory excitations; the most abstract thinking is deranged when the body is out of its normal order. The condition most favorable to the highest state of general attention is the one called "alert indifference." The subject knows his stimulus will be of a certain kind and within given limits. Thus prepared the alert indifference was found to be at its best just as one's inspiration was near its maximum. At this juncture there is a momentary relaxation, which seems to be general. Efforts to attend soon exhausted the subjects. On the view that the muscle tension is an integral part of one's idea, and that maintenance of an idea in mind and maintenance of tension in certain muscles are two aspects of the same fact, it is easy to explain

this tire of attention. The eye fails to "see" clearly because the wonted channels of expression corresponding to certain stimuli are fatigued, although at the same time the eye itself may be in good condition. Like the would-be jumper who takes a long run to get impetus and is exhausted when he gets to the scratch, so one who overstrains his muscles in expectation finds himself unable to seize, or else to react on, the stimulus when it comes. It may be well to repeat there are two distinct facts to be kept in mind of every act of consciousness: the one is a relatively simple chain of three links—end-organ, centre, muscle, and this constitutes a sensation; the other is a complex of many such links, and forms an idea.

Much has been said by the supporters of the central-origin-of-attention theory of the phenomena of attention got by introspection, but an examination of these statements will, I think, show that the condition immediately preceding any particular phenomenon is a muscle state. In other words, the psychic state is indissolubly bound with and dependent on a tension; attention follows, not precedes, that to which we attend.

Helmholtz, to illustrate the freedom of attention, cites the fact we can hold to a faint stimulus whilst a stronger one to the same sense is debarred (pp. 971-2). Evidently it is assumed that stimuli produce reactions proportionate to their objective intensity. That this conclusion is untrue, in so far as our measure of objective intensities goes, is well known. Were the neuro-muscular system always to return to a neutral state after each response, we could expect the stronger stimulus to draw the attention. Further, there seems to be the assumption that a stimulus to, *e. g.*, the eye, is shaped by that sense into an idea. James (I, 50) exposes this error. Hering (pp. 84-5) shows that clearness (the point involved in Helmholtz's claim) depends on the relation of the given sensation to its sensation environments; in other words, that the clearness of a sensation is measured by the relative strength of the interrelations of the particular tension response to the other tension states of the body at the moment. The "stronger stimulus" fails of entrance because opposed by the tension state favorable to its "weaker" rival. Wundt also accords: "The clearness of a *Vorstellung*, whether sensation or memory-image, is conditioned both by the strength of its perception elements and by the sharpness of their apperception" (1, II, 271). Interpreted in the light of the experiments given in this paper, Wundt's words state the equivalent to (a) proper functioning of the end-organ and its immediate responses, and (b) the adjustment of the latter in the general body-state. Wundt admits that an unexpectedly strong stimulus breaks up the preparatory attention-tensions (and this happens at times to such a degree that the new stimulus apperceives the mass that had awaited it); but, apparently, he does not recognize that the over-tension of the muscles concerned in the apperception of the in-coming stimulus also prevents or warps apperception. So far as clearness is concerned, its conditions may be summed up in: If attention checks irrelevant tensions, *i. e.*, if it is expended in such a way as to leave free the muscles needed to receive the awaited stimulus (or idea), it aids; if it checks these constituents, it hampers clearness.

Fixate carefully a small object (and the greater the attention the smaller is the field of application) and it soon disappears. It goes when the feeling of strain is greatest, says Helmholtz (p. 365) and Müller (p. 92). The cause of the disappearance is not that "the strain-idea has driven the object-idea out of mind" (cf. p. 569 for account of rivalry between strain and stimulus), but that the

tensions have diffused into the muscles that serve to give meaning to the acting stimulus. Wundt again: "Impressions qualitatively different require unlike adaptations for their reception. Further, we note that the amount of the feeling of inner expectation keeps pace with the strength of the impression whose apperception we complete. On the exactness of this adaptation depends the sharpness of the apperception. The latter is sharp when the inner attention exactly corresponds to the strength of the impression" (1, II, p. 271). This strength, as we have seen (pp. 548 and 550), is conditioned very largely by the tensions that receive the shock; and we are not obliged to assume any strained condition of a hypothetical inner entity as does Wundt. Our inner expectation really keeps pace with the degree of tensions, and when these lack order their conflict throws the mind into a state of emotion—the inner aspect of the confused muscles. In the experiments herein noted, perception of the time order of (faint) clicks, in § C, was best when there was no feeling of strain whatever; the strain Wundt speaks of is probably only the holding in check of muscles which might inject a disturbing factor into the intended response (cf. with experience of Mr. Luckey, p. 550). If we consider the process of apperception as progressive coördination, we see why consciousness lapses as habit grows,—because attentive consciousness is dependent on shifting tensions; as muscle groups coördinate and function *en bloc*, they escape mutual conflict, and hence give no occasion for opposing states of mind. That reactions do tend to an average status, wherein discrimination or attention lapses, is certain; it is shown by our "constant bias," by Leuba (p. 382-3), who considers it a feature of sense-memory, and again by Daniels (p. 561, n.), who notes the recurrence of certain stock errors. We are debtors to our mistakes if we take them up into consciousness and definitely build them into the way to the correct end, for thus they "lapse," as do all the stages of a series, and so no more offer seductive diversions, but form part of the wall within which our thought runs. Until such assimilation of mistakes is made, the latter are a constant source of error, and may come to be the habitual normal course of reaction. In view of these facts, it seems evident it is these possibles of reaction that determine apperception, and that Wundt's assertion, "Not the intensity and quality of a sensation in itself, but its ability to excite apperception, is the determining factor for the direction of the line of sight," is, as Wundt means it, unfounded. Perception of impressions on peripheral portions of the retina, to use specifically the illustration that for Wundt is general, is either mediated by tensions in part different from those that function with the foveal region, or there is a momentary lapse from the prescribed fixation point. Helmholtz's perception with sides of retina (pp. 934-6) is in point; despite his claim, "attention is quite independent of the position and accommodation of the eyes," there is no need even here to invoke the aid of a hypothetical inner activity. Vision with the sides of the retina enables one now and then, in flashes, to perceive the clear black and white of a disk when it is revolving at a rate sufficient to give a uniform gray. The very point so emphasized by Hering (Hermann's *Handbuch*, III, I, 548) relative to Helmholtz's experiment—that the line of sight must be held with perfect firmness—is the essential condition needed to let the side stimulus work. We cannot speak of eye, but must distinguish eyes and parts of each eye[1]; and to these parts respond different tension-complexes.

The ripening of apperception is a matter much dwelt on by

[1]Cf. C. L. Franklin, *Psychological Review*, II, p. 142, n.

Wundt (1, II, 399 etc.), who claims the mind can divide itself between two or more stimuli, or can perceive them simultaneously. *E. g.*, the stimuli got by the dial-pointer-bell apparatus need not be rivals, but, like two streams, may flow in gradually converging courses until they meet and mingle gently and indissolubly. Nor is the junction for Wundt a result of stimulation, but depends on the ripening of apperception. It matters not if there be no second member; if apperception is expecting such to come, it will act as though the to-be-interpolated stimulus had come, and thus produce "negative errors." Again, though the disparate stimuli have been given, if apperception is unripe, their taking up into consciousness is delayed until apperception is ready to admit them. The obscurity of the process, though great, is not lightened by the explanation of apperception, which "*ausdehnt sich auf die Gesammtanlage des Bewusstseins*" (1, II, 285). It seems fair to infer that by Wundt's view the two series of stimuli in question move in the sub-conscious, and fuse there. But if so, how can active apperception be said to control them? In my own experiments, results like Wundt's were often got, but explicable in a much simpler manner. In the reaction-time experiments, whilst reading, problems were side-tracked into sub- or semi-consciousness, whence their answers appeared in visual terms (cf. p. 565). As Wundt says, "The regular series ran its steady course as though no complication existed, and at a point the simultaneous stimulus joined itself to the former, not as a successive, but as an integral part of a complex idea" (1, II, 399). Yet this does not mean the mind divided itself between the parts, but that separate muscle groups responded to their stimuli, and when in a sufficiently tensed and non-conflicting state, formed the state common to all complicated acts,—and what acts are not in some degree complex? The same process that provides for the preservation of some parts in the complex is sufficient to ensure the forgetting of others.

Daniels' paper, describing work akin to Wundt's complicated reaction-time experiments, and to the study of Angell and Pierce, offers several points for comment. To the subject, while reading aloud, were read series of numbers of three figures each. The subject either ceased reading and at once repeated the number, or continued reading for periods ranging from five to twenty seconds before endeavoring to repeat. It was found the memory after-image does not last fifteen seconds in a reproduceable condition unless its response tension is repeated before its first set is spoiled by succeeding tensions. It is not that the after-image has been in mind,—in that it has a grip in tensions, lies the possibility of its recall. Table III, p. 562 (of Daniels' paper), a general summary, shows the part played in perception and retention by tensions. S., a trained experimenter with self well in hand, made uniform resistance to the impulse to diversion of attention from the reading; but as the stimulus summated its culminating part (the final number of each set) stuck far oftener than either of its predecessors. D., less trained, was unable to resist the onset of the number series, and shows an outgo to the initial number, a return to his reading (*i. e.*, former tension state), and another response to the final number. Here, as before, attention, considered as a conscious state, follows the tension response in every case.

IV.

In the opening paragraph is promised a summary of by-products of the experiments which suggested, and in turn get meaning from, the view of attention just given. The list that follows, considered

from any other standpoint, displays a motley host; but examined for tensions, as characteristics of direction of attention, it presents a homogeneity that warrants recognition. To designate the three sets of experiments, A will be used to indicate the reaction-time, B the association, and C the least interval, group.

In A and in the distraction half of B, the set tasks were more or less hampered by the many and conflicting demands made on the vocal cords. The mere fact that ideas are known in, or by, a nervous system necessitates the presence of some form of expression as an inevitable accompaniment of every stirring of consciousness. By the time any stimulus gets to consciousness, it has found outlet in muscles, and because of our great need for names, a part of this expression is usually in the larynx.[1] Hence use of the voice proved the most distracting device, because of the almost inveterate effort to put our thoughts into verbal form; unless other channels were ready, attention balked. Exceptions that go to illustrate how little depends on conscious direction of attention and how much on diffusion of the stimulus until it finds an accustomed channel, were found. *E. g.*, in A, problems given orally were sidetracked into semi-consciousness, whence they reappeared with visualized answers; in B, thought went on without special names, in a general yet accurate way. Yet in all these cases a general feeling of congruity is our guide, and we do not realize our errors—so frequent—until after they are made; in other words our attention, considered as a mental oversight, follows the tension. Daniels (p. 561, n.) notes an incident common in all similar experiments — the easy formation of habits of response; *e. g.*, any answer once given, whether correct or not, was often repeated. Here it is evident the mind is easily satisfied and directs its attention along the line of habitual tensions. In Daniels' case the vocal cords were in use, and the stimulus given (a group of three numbers) tended to evoke its proper response; as the subject felt himself yielding (*i. e.* as his cords tended to shift one position for another), he resisted not the thought, but the shifting of tensions by putting greater strain on those in use. As forgetting is not doing, so by refusing to name the numbers pronounced, the subject lost the power to recall them; later effort so to do led to discharge in the habit-tracts,—these being uninfluenced by the previous strain. For brevity I have spoken as though all centered in the larynx; while this may not be the case, the point involved is not affected. The fact that in C perception was not hampered by loud reading, save when the latter made one oblivious to sound stimuli, indicates the trouble caused by distraction lies not in the receptive, but in the expressive sphere. Two things cannot be done, nor thought of, at the same time if they need the same or opposing muscles for their execution; if, however, different muscle groups are exercised, many acts can be simultaneous. As so stated this is self-evident, yet many experiments have been made to prove it (cf. Paulhan); further may be noted: in A partial products fused of themselves; in B associations presented themselves (cf. Wundt, 1, II, 398-9); in C the click or shock gave its own order. In none of these cases, as a rule, were the results got by any "direction of attention;" they came in spite of distraction, were mediated by tensions other than those in use for the distraction. If the term "conscious" be restricted to those processes of which we are immediately aware, then the results just noted, of thoughts that appear full-grown, may be said to come from the unconscious. Ac-

[1] In accordance with the laws of simplicity and economy of effort, the flexibility of some parts of the vocal apparatus far exceeds the rate of any other voluntary act.

cept this limitation and our experiments throughout show that fatigue lets the unconscious work, *i. e.*, it lessens distraction, permits a freer distribution of attention. If fresh we had more force available than laboratory experiments required and the inevitable overflow came to light in spurty tensions and frequent responses to irrelevant matters. Too great strain entailed a cramp that prevented some of the most customary associations in B, but these were made so soon as the strain eased (cf. Lalande and Paulhan). In the "unconscious" work noted above, a certain order seemed imperative. Factors in A had to be put in a habitual way; in C the bias, or constant error, defied our efforts at conscious control.

The usual muscular tensions that characterize or accompany concentration of attention, were well marked in all the experiments. Checked breathing, suspension of movements, a strain about eyes or ears, were common. In C the effort to hold an even hand between stimuli to organs of the same sense brought out clearly the great dependence of "balanced attention" on equilateral tensions. To be alert and yet neutral, *i. e.*, to be intentionally indifferent, it was necessary to fixate a point in the median plane and to have an equal distribution of tensions on each side of the body. The slightest deviation therefrom, if but a tendency to a side-movement of the eyes, was sufficient to make uncertain the judgment of the order in which the clicks came. As concentration is tension, it easily passes by overplus into distraction, or opposing tensions. In A uncalled fingers, and even the whole arm, made irrelevant reactions; in B the very effort for great attention defeated its aim; in C the order was easily lost when too much awaited. But attention is not only a matter of tension on its physical side. Without change concentration soon degenerated into stupor; all distractions soon dulled; in each case aid was got, both for concentration and for distraction, by shifting positions. The readjustment of tensions was conducive to distraction if the stimuli were received whilst the change was in progress, because the correct response was but one of many possible tensions; if the stimuli came when the tension-adjustment was just below its crest, they found favorable reception. To get the faint clicks in C, concentration (*i. e.*, suspension of motion) had to be very great; my custom was to draw a full breath and begin to expire just as the clicks were expected. The momentary balancing on the tension-crest enabled the clicks to come as if into the field of vision.

So inveterate (or normal) is the habit of association that it is practically impossible to get trace of an idea without giving it a space setting. Definite localization was all but general; those few cases wherein it failed may probably be explained as unscrutinized. In A the stimuli, coming from the operator, seemed to be external in nature; they and their responses were free from subjective control. In B and C the associations and sensations were projected, and their spatial distance was usually strongly felt. In B at times the consciousness of place was greater than that of the object felt to be there. In C if the focus, fixated in order to keep attention median, was distant, the stimuli were remote; if near by, the stimuli came near. The evident reason for these facts is that an idea rests on a complex, each element of which has its harmonious space-reaction. The nature of a complex idea (an object of thought composed of known elements) necessitates a play of tensions to give its full expression, and full presence as well. Put into terms of an inner activity this kaleidoscopic play may be formulated in: Ranging is necessary for fruitful attention, *i. e.*, in order to get many associates. Mere attention, considered as fixation, lands the mind in

blankness. The fact noted above, that some distraction is an aid to work, finds an inner correlate in the need of "ground-wires" to draw off the excess of energy. The non-attended incidents and possible stimuli about us (for concrete, though extreme, stock-cases, take the button of Scott's class-mate, Schiller's rotten apples, the uproar of the mill) are the background on which we project and estimate our heeded experiences.

Spatial readjustment of our mental stock was often a very conscious and troublesome process. Thus, in A difficult problems were analyzed and solved piece-meal on the lines of least resistance; in B perplexing key-words were dismembered and referred to their root-origins; in C the sensations were commonly translated into objective figures. In B it was necessary to arrange the associations in groups in order to retain them; in C the time order had to be decided by an immediate impulse, else would consideration drive out the possibility of decision. Our experience in C indicates that judgment of time order depends on one's interpretation of his space-experiences. Space to us is largely a matter of projection, and with normal persons this is in terms of sight (cf. Wundt, 1, II, 121-2). So long as the subject in C was fresh and passive, the time order of the stimuli was well perceived; certainty was greatest when there was least conscious effort to decide. Quite otherwise was the matter when for any reason, fatigue or wandering mind and shifting tensions, the order was obscure. In the latter cases decisions, as noted above, wavered between feeling and judgment, *i. e.*, between the impulsive and the conscious. Yet when these opposing claims were examined, I could not see there was anything else to motive them than differences of perceived intensity. My impression is that in the immediate, sensory form the body-state was in a condition of alert indifference; that in the "feeling" form the body-state was one of change, but that the stimulus-tension got and retained a relatively stable condition which, in time, often sufficed to gain it notice. In the last named form one wonders if he started from the stimulus and went to the related ideas, or from these latter over to the idea about the stimulus. But as has been said, when the immediacy of the struggle, the basal feeling of the sensation, was gone, the case was rejected. It should be remembered, however, that these uncertain cases were but a fraction of the series; often subjects gave correctly the order of nearly entire sets (twenty trials each), and were sure of their answers. The doubtful cases bring out the fact that the stimuli were known as unequal; of this, more later.

A constant error, rather a general bias, has been noted in the experiments of the third part. It was easier to decide for one side than for the other, as was shown by the preponderance of correct answers on the favored side, due, probably, not to better perception, but to an excess of answers in one direction. This is akin to habit, perception of the probable, apperception ruts, and, I believe, is related to certain fixed muscle adjustments. For S. and D. this constant error has been shown in Table 4, and in 13 is shown the result of shifting body conditions with intent to redistribute tensions. Although various subjects knew of this failing and endeavored to guard against it, the undertow was too strong to be resisted. At times the bias was maintained, although the intensities of the stimuli were made to differ considerably; now and then the error would change from one side to the other, but in the long run it was fairly constant. Because of this bias, experimentation with some subjects was given up.

Here may be noted the observation that organs of the same sense

receive like stimuli in unlike ways. Differences in the abilities of the eyes and of the ears are well known; analogous is the case of the hands. For a time it was possible to judge the order of shocks in C by these qualitative differences in sensation. There was needed a certain degree of intensity in order to arouse these sensation-forms; below the minimal quantity quality failed to appear. In the case of the very faint clicks this loss of quality was very great. At the outset and for some time thereafter, these were projected on a level with and a trifle back of the shoulders; they were seen, with the eye of imagination, as whitish spots on black backgrounds, like the pictures that represent stars in constellations in astronomical text-books. As intensity increased the clicks became more like experiences known as sound, and so came up toward and into the ears. Yet, unless the subject was in good responsive condition, at the short interval (.024σ), with increased intensity the clicks would overlap, either in a confused sound, or as overlapping auroral flashes, in terms of sight, and before the face. When the clicks were really simultaneous, they were perceived as one located in the occipital part of the brain. In every case as intensity grew, the clicks approached each other; due, probably, to the fact that the tension responses were greater, and so intermixed. Bolton (p. 228) notes, "The strongest sound seemed longer than the rest;" because its effect, more widely diffused, aroused the idea of extension.

It was our custom in C to interchange the battery connections, whereby the stimulus that had gone to one side should be sent an equal number of times to the opposite side; by so doing we sought to neutralize any lurking inequalities. But one day, while using shocks with indifferent attention, we crossed our arms and thus received the right hand shock in the left hand, the shock from the left side in the right hand (cf. p. 550). To our surprise the stimulus in one hand would at times entirely disappear, and when felt was much weaker than its mate. That the objective intensities were unchanged we proved by tests; that the trouble was not a local defect was shown by the fact that at times a plain after-sensation of the shock could be felt in the fingers, though the original sensation had escaped detection. On some days the loss of the shock was especially common in one hand; at other times the opposite hand so suffered; while on yet other days the loss shifted back and forth. Knowing that both shocks were given and of like intensity, one could not avoid watching for a sensation on the perplexing side; but expectant attention in this case was not equal to sensation, although often it was impossible to decide whether a faint trace of the missing sensation had been felt or imagined. These cases seem to be veritable cramps of attention. In one series, designed to get twenty judgments, after nine had been given, I had twenty-one trials on the tenth before making a (guess) judgment. Here shifting one's position did not aid perception. After the eighth trial I walked about to shake off the cramp; after the tenth trial the left cup (by which no sensation had been aroused) was tested and its stimulus found to be working normally. In this case the trouble, though present in a few early cases, did not become set until the series was half done. Another day the cramp began at the outset, and forty trials were made before a judgment could be given; in the final trial the stimuli were plainly felt in both hands, and in their order; in every trial the stimuli had been sent and in changing order. Thirty of the trials were made with right hand above, the remainder with left above. In the thirty-second trial the right-hand shock was missing; in the others of this set the trouble was

with the left side. Not that the left stimulus was always entirely absent. In this particular set my notes show six times when the left *seemed* to lead, although the only stimulus "known" was felt on right; each of the six was a case of left first. When the bias to one side (and especially to the right) was strong, the shocks on the left became dissociated from the fingers, and commonly settled in or near the median plane, at the crossing point of the arms.[1] Two naïve subjects who were used to test this matter, found the median plane tangle; but, introspecting less, and less anxious for exactest judgments, they did not stick on the dead centre, but guessed themselves out of the difficulty. That the trouble was not in the apparatus was certain. The stimuli were given by the break, which gave a stronger shock than the make. In a troublesome run, in which one side repeatedly failed to take part, a slight delay in removing the hands from the cups enabled me to feel the make. So unexpected was this that, despite its real faintness, it startled me far more than had the regular stimulus.

If the non-appearance of the stimulus noted above be due to an attention-cramp, it may be asked to which side attention was given. As a rule it is next to impossible for one designedly so to control his attention as to become oblivious to surrounding stimuli; the very effort to turn away from a stimulus often puts its claim more forcibly. So, too, it was practically impossible for one to fail to perceive an awaited stimulus without becoming disposed to be alert for its coming; yet the positive and strenuous direction of attention actually did less to facilitate perception than did a state of indifference. In general the shocks in the side to which attention was given were felt as being much weaker than those in the unattended side,—doubtless because the strain diffused until it cramped the mobile parts needed to receive the expected shock. This fore-tension explains in part why "not even shock affects the muscular form of reaction," for not only is the shock's work begun, but once begun, the probability of diversion is lessened. In a sense it may be said, "Expectant attention and sensation [are] identical processes." (James, I, p. 429). In the case noted above the tension in the attended hand was as great as, or greater than, that produced by the shock, hence the latter was felt little or not at all. In the other hand the contrast between the relaxed and the contracted conditions gave a good example of passive attention, with a difference of states so great as to compel regard. Hence in this experiment serial order was often upset, because at times the only shock-tension experienced was in the non-attended hand, and this was heeded because the only other mental rival was the consciousness of a cramp. In truth the latter was no rival. Treating the hands as disparate senses, the case was akin to our common experiences wherein we refuse response to so-called distractions. Again it may be said a certain amount of distraction facilitates perception, in that it prevents this overflow of tensions (compare Urbantschitsch and Münsterberg, 4). "Distractions" need to be further differentiated, since they may be more attractive and absorbing than one's set task, and so fill his mind; or they may be suggestive of varied associates and so make concentration all but impossible.

It may be objected that the illustrations given of cramped attention are all exclusively physiological, and the extension of inferences therefrom to ideas questioned. But quite similar were the experiences in B—association. While adding for distraction, it was

[1] Compare "An Experimental Study of Simultaneous Stimulations of the Sense of Touch," W. O. Krohn, *Journal of Nervous and Mental Diseases*, March, 1893.

much easier to have "knowledge-about," *i. e.*, to broadly survey, one's addition, general feeling, flight of time, progress of the experiment, and the like,than it was to attend to the key-words. The effort to hold fast the word bred stupor, gave cramp; the tensions corresponding to the work of addition, one's acts, etc., were in continual change. Whole sections of common thought were often left untouched during the time allotted for association.

In any discussion of Attention we need to consider first the name, for it is a word that includes in its various meanings all mind action—passive and active,—and because of this range its explanatory value is but a pretence. Leaving aside the fact that consciousness is active *per se*, the attention that we know is a resultant of tensions, *i. e.*, an element in knowing and so is present in all states of mind. What the motive power back of this tension is, we do not know; but nothing is gained by giving it a name of ignorance and then subdividing this X into active and passive forms. We feel mind action to be passive when aroused chiefly by sensory means (and these include a large part of the suggestions that motive idle revery); active when aroused by ideo-motor means. In the former we find ourselves in an attentive state because of the impulsive response of sense-organ adjustments; these in cases, *e. g.*, iris and lens, go on out of mind. In the latter the kinæsthetic idea is necessarily in mind before its sequent steps are aroused, and the mind, prevising, feels its initiative. In either case attention as a psychic state follows and depends on tensions.

The study noted in these pages was carried on under the general direction and with the constant aid and counsel of Dr. E. C. Sanford, to whom my thanks are due in large measure; however, he is no way responsible for the short-comings. To President G. Stanley Hall for stimulating suggestions and insights that rouse one to new views, and to Dr. W. H. Burnham for sympathetic criticism and assistance all along the way,—I wish especially to acknowledge my obligation. Nor would I omit to recognize my debt to Mr. Jonas G. Clark, to whose generosity is due the facilities so abundantly furnished for my work. It is a privilege to thus express my indebtedness to these men, for, because of them, the work was made a pleasure.

V.

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NOTE.

While Mr. Drew's experiments on Association were in progress, I undertook a similar series in order to check his results by those of a second observer. The method used was not quite the same, the most important difference being a greater freedom of association on my part, *i. e.*, each association was not held strictly to the original stimulus word. The nature of the data gathered in such experiments makes it almost indispensable that each observer should work up his own results, and this I have not found time to do, with sufficient completeness for exact tabular presentation. I venture, however, to give here such general statements as a rather full preliminary examination seems to justify.

In the first place my lists, like those of Drew, show little difference in the fertility of association between those series in which addition was performed and those in which attention was left free. This unexpected result may depend, as he suggests, on an unintended distraction, introduced by the knowledge that the time for getting associations was limited, or on the fact that in most cases there was not thorough absorption in the adding, the associations being secured at intervals of slight neglect of the means of distraction. Another effect of the adding is apparent in my case, however, in the greater number of cases in which wholly extraneous ideas entered, or in which an association once glimpsed was lost in whole or in part before the time came for recording. The subjective feeling of greater irksomeness also distinguished the tests accompanied by addition, and introspection seemed more difficult.

The most marked qualitative difference between the series with adding and those without is a clear preponderance in the latter case of associated phrases (quotations and the like). A similar relation, though quantitatively much less, appears in Drew's table F, where the percentage of "word" associations is greater in the series with full attention. This difference may be caused by the need of at least a partial functioning of the language apparatus, central and peripheral, in the adding (cf. the article of Theodate Smith above).

As with Drew and other experimenters by this method, a considerable number of associations noted in the first trial with each series recurred again in the second trial, but the distribution of repetitions among the series is different in my case from Drew's, the series in which adding was used in both trials standing out alone with a decidedly higher proportion of repetitions than the rest.

Of Drew's observations during the course of the experiment, several were very frequently confirmed in my series, most strikingly of all the tendency to internal speech and to the immediate spatial location of the associations started. The very first thing that could be observed in most cases, after the method of work had become familiar and the operator practiced in introspection, was a mental pronunciation of the stimulus word, and a verbal accompaniment was also found with many of the succeeding associations. The tendency to locate followed immediately upon the recognition of the stimulus word, or possibly as a part of its recognition. At times it served as a sort of algebraic symbol, and took the place of a more tardy but fuller image in visual or other terms. It was often a kind of mental pointing, an unformed "that thing, there." No classification according to period of life was attempted in my case.

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PSYCHOLOGICAL LITERATURE.

The Theory of Knowledge. A Contribution to some Problems of Logic and Metaphysics. By L. T. HOBHOUSE. London, 1896, pp. 627.

According to the author, the world of thought at the present day is in a somewhat anomalous amorphic condition. The warehouses of science are being filled to repletion with an accumulated mass of facts, the details of which even a Heaven-born Aristotle could not properly grasp and unify. The deluge of specialism still continues. Systems of philosophy that antedate this deluge are therefore undermined by it; a new construction is necessary. The philosopher, like the theologian, has not the hardihood of the past; he proclaims with more diffidence than formerly his God-given panacea of all difficulties. Moreover, there is an elegant skepticism abroad. The question is not only, Is philosophy skeptical in its tendency? but also, Is not science bankrupt? It is the elegant, aristocratic thing to do, to languidly lean back in your carriage as it rolls along Rotten Row, and to declare that that is immutable and sure which—suits your needs. The author endeavors, in a fair-minded way, to present to us the result of some "psychical chemistry"—he will unite the merits of Mill and Spencer with those of Lotze and Hegel, and present a higher whole.

The work is too large to allow of an analysis of it here, but a few points may be noted. Logic, in contradistinction to psychology, we are informed, examines the content, grounds, and validity of belief in general. In logic we have to deal with knowledge, that is, the relation of belief to fact. It may be asked, are not our beliefs facts? and if our beliefs are not facts, how are we to find out the difference—by other beliefs? This is decidedly a topic for psychology preëminently. Knowledge of the immediately present may be called apprehension and this the starting point of knowledge. The content of immediate apprehension is extension, size, shape, position and time. The atomic sensation is a figment. Memory "is not a mere image or fainter repetition of something which is *de facto* past." Such an image could be only—an image, a present fact, "which vanishes in its turn and requires memory to recall it from the limbo of departed thoughts." "Memory, then, is an assertion—or, if you prefer to employ the word as a name for a permanent capacity of the mind unknown to us except by its results—it is a faculty of making assertions." "It is an assertion of the past, and hence a reference to something not now present," which appears to amount to this, that the past or the knowledge that an event is past is an assertion of the past, a statement perilously similar to the so-called Law of Identity. "Judgment affirms the reference to reality contained in an idea," and "in so doing it necessarily predicates something of something otherwise known." "Negation rejects a suggested reference." The author further treats at length of inference and knowledge, enlarging on the doctrines of the conception of external reality, substance, etc.

The author is, on the whole, somewhat diffuse, often quite diffuse, but is very fair-minded, an accurate psychologist, and has furnished an admirable exposition for students as well as a suggestive treatise for others.

ARTHUR ALLIN.

Psychology and Psychic Culture. By REUBEN POST HALLECK. American Book Co., New York, 1895.

Mr. Halleck's psychology, which comprises some 360 pages, is designed as a text-book for high school pupils, and to quote from the author, "aims to present the latest ascertained facts of physiological as well as of introspective psychology."

The book is dated 1895, but none of the more recent contributions of French and German psychologists are mentioned, nor does the author manifest any acquaintance with much of the psychological literature available in English. A pupil might read the book carefully from beginning to end without so much as a suspicion that such things as psychological laboratories existed. On p. 65 Weber's law is thus stated: "To produce a change in any sensation, the stimulus must be increased one-third."

The book retains the old faulty classification of mental phenomena with some justification, since the text-book is an elementary one designed for pupils under twenty years old, but to give no hint that any other method of treating the subject exists, is scarcely in accordance with the author's claims. In the chapter on the emotions, the only authority to which the author refers for expression of the emotions is Darwin's "Expression of Emotions in Man and Animals" (1873). The book is really of the age of Porter, with a very thin and spotty varnish of more recent information.

The best portion is that which is devoted to practical precepts for emotional and voluntary control. Here the author has evidently read Prof. James' chapter on "Habit" to some purpose and uses illustrations well adapted to the design of the book.

THEODATE L. SMITH.

L'Année Psychologique. Par H. BEAUNIS et A. BINET, avec collaboration. Deuxième Année, 1895. Paris, Felix Alcan, 1896.

Psychologists are again heavily indebted to the perseverance and industry of MM. Beaunis and Binet and their collaborators. This number of *L'Année*, as the last, falls into three parts, devoted respectively to original articles, to general reviews of literature in several important fields, and to summaries and reviews of the publications of the year. The first two and last form almost equal parts of the entire work,—about 500 pages each.

The volume begins with an article by Prof. Ribot (Paris), "*Les Caractères anormaux et morbides.*" Under this title are treated those unstable types of character which range in intensity from the change accompanying religious conversion, or the two phases which the same individual shows in his place of business and his family circle, to the morbid forms of double personality. All these types are reduced to one, whose differentia is a lack of proper subordination of the different tendencies in the character; and the term *infantalisme psychologique* (psychological childishness) is proposed to cover the entire class.

Prof. Forel[1] (Zürich) contributes "*Un aperçu de psychologie comperée.*" The article is based upon a discussion of the nature of consciousness in its relation to the social habits of ants. The social actions are reduced to automatic movements, mainly the function of ganglia in the head,—which persist in the race by survival. The development of consciousness in general is stated to consist in the subordination of the various independent groups of automatic actions to some one central group. The treatise is made the basis

[1] Page 18.

for long disquisitions upon the nature of consciousness and the rival theories of heredity. The article contains much suggestive matter, though it is not always easy to see how some of the subjects treated are related to the main theme.

Prof. Flournoy[1] (Geneva) gives the results of an interesting investigation into the times of reading and omitting words. Two lists of twenty-four words each are prepared, in each of which twelve words come under some general category. In the first list the subject is required to read all the words which come under the category, in the second to omit them. It is found to require 25% more time to omit than to read a word. The writer's experiment does not seem quite "pure," however, since it assumes that the times of reading and omitting the words which do not belong to the category remain constant. The fact is taken to prove that the negative judgment is not so immediate as the positive; and this is explained in terms of a predisposition of the cortex to pronounce the words which come under the general category expected.

The results of some experiments upon association are presented by M. Bourdon.[2] The contribution is mainly valuable as an attempt at a method of classifying the results of introspection. It affords in this way much material as to the nature of the mental processes which underlie reading and the formation of successive associations in general.

Prof. Van Biervliet[3] (Ghent) continues the investigation, begun by Flournoy, Dresslar, and Seashore, of the illusion of weights of various sizes; and obtains practically the same results as those authors. The results are stated in the formula that apparent weight varies directly with actual weight, and inversely with volume. Flournoy's disproof of the innervation sensation is challenged, — it seems, on insufficient grounds,—by the statement that volume acts through vision or the cutaneous sensibility upon the innervation sense.

"*Circulation Capillaire de la Main*,"[4] by MM. Binet and Courtier (Paris), gives an accurate study of the effects of respiration, of the position of the arm, of cold, of noises, and of mental work upon the pulse. The paper is remarkable for the ingenuity with which many sources of error have been discovered and eliminated. The most important result of the experiments was to show that many constant individual peculiarities exist, and persist over long periods of experimentation. The investigation is to be extended to the effects of the emotions, and the results are promised for the near future.

The same authors give an account of a method for applying the graphic method to study the action of the fingers in playing the piano.[5] A Marey tambour is connected with the keys of a piano in such a way as to record the intensity, duration and form of the pressure exerted in striking them. This affords an excellent means of studying the finer shades of expression in music, and of discovering the errors which are made in rendering a selection.

M. Paul Xilliez[6] finds that a list of figures tends in memory to become continuous,—that is, that the arithmetical differences between the succeeding numbers in the series tend to decrease.

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[1] *Note sur le "Temps de Lecture et d'Omission,"* p. 45.
[2] "*Recherches sur les Phénomènes Intellectuels.*"
[3] "*La Mesure des Illusions des Poids,*" p. 79.
[4] Page 87.
[5] "*Recherches Graphiques sur la Musique,*" p. 201.
[6] "*La Continuité dans la Mémoire immédiate des Chiffres et des Nombres en Série Auditive,*" p. 193.

In "*Le Peur chez les Enfants*,"[1] Prof. Binet gives the results of a *questionnaire* on morbid fear in children, addressed to French teachers. The results show the great prevalence of such morbid emotions as fear of the dark, of solitude, and of loud noises. It is found to be coincident with poor physical development, ill health, and with a vivid imagination, and to be more frequent in girls than in boys. The article ends with some practical directions for overcoming the psychosis.

To M. Victor Henri has been intrusted the work of the volume upon cutaneous sensibility. He contributes an original article, "*Recherches sur la Localisation des Sensations Tactiles*,"[2] which embodies the result of his recent work in the Leipzig laboratory and the "*Révue générale sur le Sens de Lieu de la Peau.*"[3] In the former article M. Henri insists upon the advantages of localizing a touch upon the skin on a photograph or model of the member, instead of upon the member itself, and upon the value of introspection during the experiments. His results are practically coincident with those of his previous contribution to the subject. In the explanations of the results, much attention is paid to the influence of the visual image, but the author does not seem to be familiar with Miss Washburn's treatise on the subject. He promises, however, to give a complete theory in a later article. The general review of the literature is admirable in the main, though here again, perhaps, a slight tendency is shown to underestimate work which is not done by the author's own method.

MM. Binet and Henri collaborate in a review of the work done upon what has now come to be termed, technically, Individual Psychology.[4] They suggest a new series of simple tests to supersede those now in use, which were proposed by Jastrow, Cattell, Kraepelin, and Münsterberg. The tests are intended to cover ten processes: memory, the nature of the memory image, imagination, the faculty of comprehending, suggestibility, æsthetic and moral sentiments, the force of muscle and will, and motor adaptability.

Many ingenious tests are given under these heads, which are selected from those departments in which individual variations are greatest. The entire series can be applied in an hour and a half, and requires no elaborate apparatus. It is only to be regretted that the authors should find it necessary to sacrifice scientific accuracy of statement to popular exposition. The faculty of comprehension and force of will belong to the psychology of Wolff rather than to the psychology of the laboratory.

In addition to these reviews, Dr. Azoulay covers the recent literature in the field of histological psychology, M. Jacques Passy gives a thorough and comprehensive résumé of the important literature on the olfactory sense, and M. Henri gives one of the clearest and most comprehensive statements of the use of the theory of probabilities in psychology that has as yet appeared.

The reviews and abstracts of current literature occupy the third part of the work. This is, for the most part, a model of what such work should be. The abstracts themselves are in the main very thorough, and always extremely clear. The arrangement is excellent, and the work will undoubtedly prove of great value to the psychologist. It is difficult to see how the work, as a whole, could have been improved.

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[1] Page 223.
[2] Page 168.
[3] Page 295.
[4] "*La Psychologie Individuelle*," p. 411.

The bibliography and index are translated from those prepared by Messrs. Farrand and Warren for the *Psychological Review*.

One closes the book with a feeling of wonder that the editors—M. Binet in particular, upon whom the greater part of the work seems to have fallen—found time or energy to do so much, and to do it so thoroughly. W. B. PILLSBURY.

Pour et contre l'Enseignement philosophique. Extrait de la Revue Bleue. Paris, Alcan, 1894, pp. 178.

The articles and replies which compose this volume appeared in the *Revue Bleue*, between January and May, 1894. The articles were written by the journalist, M. Fernand Vandérem, on "*l'Enseignement de la Philosophie: Une classe à supprimer*" in the above *Review;* the letters form replies to and discussions on these articles contributed by the leading educators of France, amongst whom are MM. Th. Ribot, Boutroux, Paul Janet, Fouillée, Marion, Marillier, l'abbé Clamadieu and H. Taine.

The volume contains no statistics, little or no precise data, and the proposed reforms are only hinted at; it is largely a popular discussion on the present status of philosophical instruction in the lycées of France. M. Vandérem says he wrote the articles in question "from intuition, memory and *sentiment* mostly, without documents, with a complete ignorance of the analogous controversies which had preceded." He writes with grace and ease, and with the delightful *insouciance* characteristic of a French journalist.

His fundamental criticisms, directed not against philosophy in general, nor against the university, but against the present method, quality and quantity of instruction in philosophy, are on the whole supported by the other writers. Summed up, his charges may be stated thus: The course of studies in philosophy is too full, too over-burdened; the professors have not the time to compass it; the instruction preparatory to philosophical instruction is unsuitable; the scholars are hence not prepared to comprehend it; the professors are above their task in matter of knowledge, and "are not able or do not deign to lower themselves to it;" the rôle of instruction in philosophy is to teach the pupils not systems, but to think,—to form not erudite metaphysicians, but reflective and moral minds; in this sense the courses of study ought to be corrected, and in this sense the professors ought to teach.

M. Th. Ribot writes: "I would say (and I could cite high authorities, too, if need be) that too often the instruction is above the heads of the pupils; moreover the greater part are dissatisfied with it, and the others become intoxicated with generalities and formulæ, under which they are unable to subsume anything, because for that years would be necessary. The defect lies in the course of studies, but more especially in the methods." This cry is again voiced by M. Boutroux: Instruction in philosophy is an initiation into philosophical reflection, it is not a hasty exhibition of all philosophy and of all the history of philosophy in a short space. M. G. Monod objects energetically to present state of affairs and to the "*scribendi cacœthes philosophique*" engendered by the present system of teaching. M. Fouillée wishes to extend the course in morals, and especially social ethics. M. l'abbé Clamadieu wishes to simplify the matter and to introduce philosophical instruction into all the classes without prejudice to a class in "*philosophie finale.*" M. Vandérem concludes that all those who are the reputed leaders of thought in France have pronounced in favor of a remodeling of the course of study and of a betterment in philosophical instruction.

ARTHUR ALLIN.

NOTES AND NEWS.

Mr. C. H. Judd, a graduate of Leipzig University, has been appointed instructor in Psychology at Wesleyan University. Mr. Judd is at present engaged upon a translation of Wundt's recently issued *Grundriss*, under the direction and with the coöperation of the author. The book will be published by Engelmann of Leipzig.

Mr. H. C. Warren — whose appointment at Princeton University should have been given in the previous number of the JOURNAL as that of assistant professor—has become associate editor of the *American Naturalist*, with charge of the department of Psychology.

Professor Titchener has undertaken the translation of Wundt's *Physiological Psychology*, 4th ed. The translation will be published by Swan, Sonnenschein (London) and Macmillan (New York). It is hoped that the first volume will appear in September, 1897.

Mr. E. L. Hinman, a Ph. D. of Cornell University, has been appointed instructor in Philosophy and Psychology in the University of Nebraska.

Miss Alice J. Hamlin, Ph. D. (Cornell), has been selected to teach Psychology in Mount Holyoke Seminary.

The preliminary announcement of the *Dictionary of Philosophy and Psychology*, to be published by Macmillan & Co., under the editorial supervision of Professor Baldwin of Princeton, in 1897, mentions the following as the general features of the work: "It will contain concise definitions of all the terms in use in the whole range of philosophical study (philosophy, metaphysics, psychology, ethics, logic, etc.). It will contain such historical matter, under each term, as may be necessary to justify the definition given and to show that the usage suggested is the outcome of the progress of philosophy, together with special historical articles. It will have very full bibliographies, both of philosophy generally and of the special topics which are connected with it." Psychology will be cared for by Professor J. McK. Cattell, Mr. G. F. Stout, Mr. W. E. Johnson, Professor E. B. Titchener and the editor (normal psychology), Professor Jastrow (mental pathology and anthropology), and Professor Lloyd Morgan (biology).

BOOKS RECEIVED.

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DYDE (translator). Hegel's Philosophy of Right. Pp. 365. London, George Bell & Sons, 1896; N. Y., Macmillan & Co. Price, $1.90.

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FOUILLÉE. Le Mouvement Idéaliste et la Réaction contre la Science positive. Pp. 351. Félix Alcan, Paris, 1896. Price, 7.50 f.

GIDDINGS. The Principles of Sociology. An analysis of the phenomena of association and of social organization. Columbia University Press. Macmillan & Co., N. Y. 1896. Pp. 476. Price, $3.

LÉVY. Psychologie du Caractère, Contribution a l'Éthologie. Pp. 207. F. Alcan, Paris, 1896. Price, 5 f.

LUQUEER. Hegel as Educator. Pp. 185. (Columbia University contributions to philosophy, psychology and education, Vol. II, No. 1.) N. Y., Macmillan & Co., May, 1896. Price, $1.

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Proceedings of the American Medico-Psychological Association at the Fifty-first Annual Meeting held in Denver, June 11-13, 1895. Published by the Association, 1896. Pp. 258.

RIBOT. La Psychologie des Sentiments. (Bibliothèque de Philosophie contemporaine.) F. Alcan, Paris, 1896. Pp. 443. Price, 7.50 f.

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STOUT. Analytic Psychology. 2 vols. Pp. 289-314. (Library of Philosophy. Edited by J. H. Muirhead, M. A.) London, Swan, Sonnenschein & Co., Ltd.; New York, Macmillan & Co., 1896. Price, $5.50.

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